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Photo 34. A view from the stage, probably late 1944 or early 1945, shows the footlight sockets and wiring. The window and black-out curtains at the north wall windows are also illustrated. On the sides of two columns, just above the dark portion of the painted wall wainscot, are cleats for curtain pulls. Some of these are still extant, as well as pulleys in the ceiling above adjacent to the columns for drawing the black-out curtains. Toyo Miyatake Collection, No. 95, courtesy Archie A. Miyatake, San Gabriel, California.

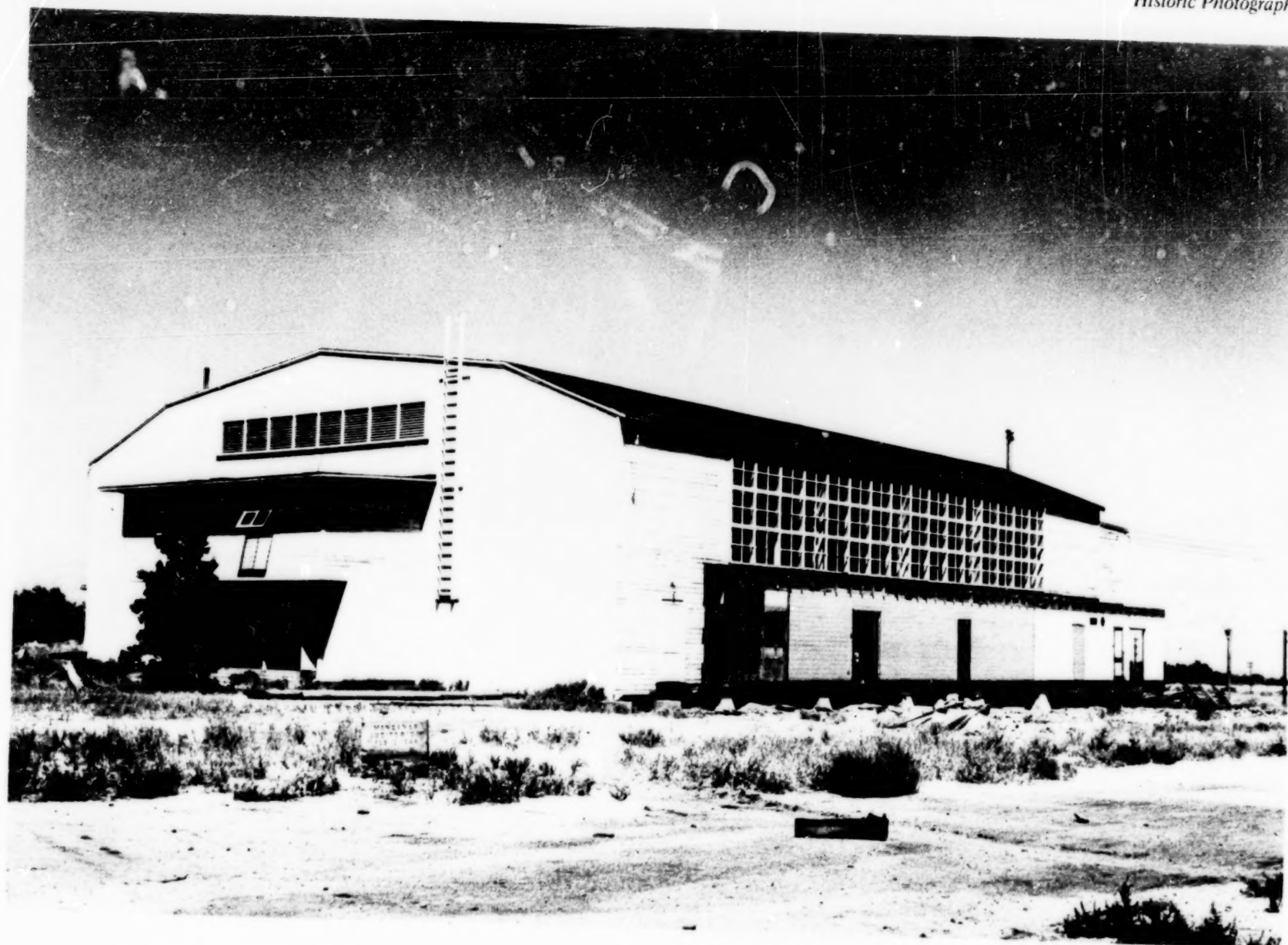


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Photo 35. The auditorium was used between 1947 and 1954 by the Veterans of Foreign Wars. This view of the auditorium from the southwest was shortly after the south wing was removed, probably 1954. The VFW moved the south wing structure to Lone Pine and placed it there in an L-shaped configuration. It is still in use by the local VFW chapter and the Lone Pine American Legion Post. The doorways in the second and fourth bays from the west were probably added after 1947. The horizontal board wall finish which was originally within the interior of the south wing and then exposed to the exterior was cedar, typical of the interior wall finish. The exterior siding on the other hand was Douglas Fir. Also exposed by the removal of the south wing and visible in this photo are the concrete footings supporting columns in the main south wall of the auditorium. The cornerstone is in the left center foreground. The pine tree near the west main entrance had substantially increased its height since 1945. Toyo Miyatake Collection, No. 87-G, courtesy Archie A. Miyatake, San Gabriel, California.

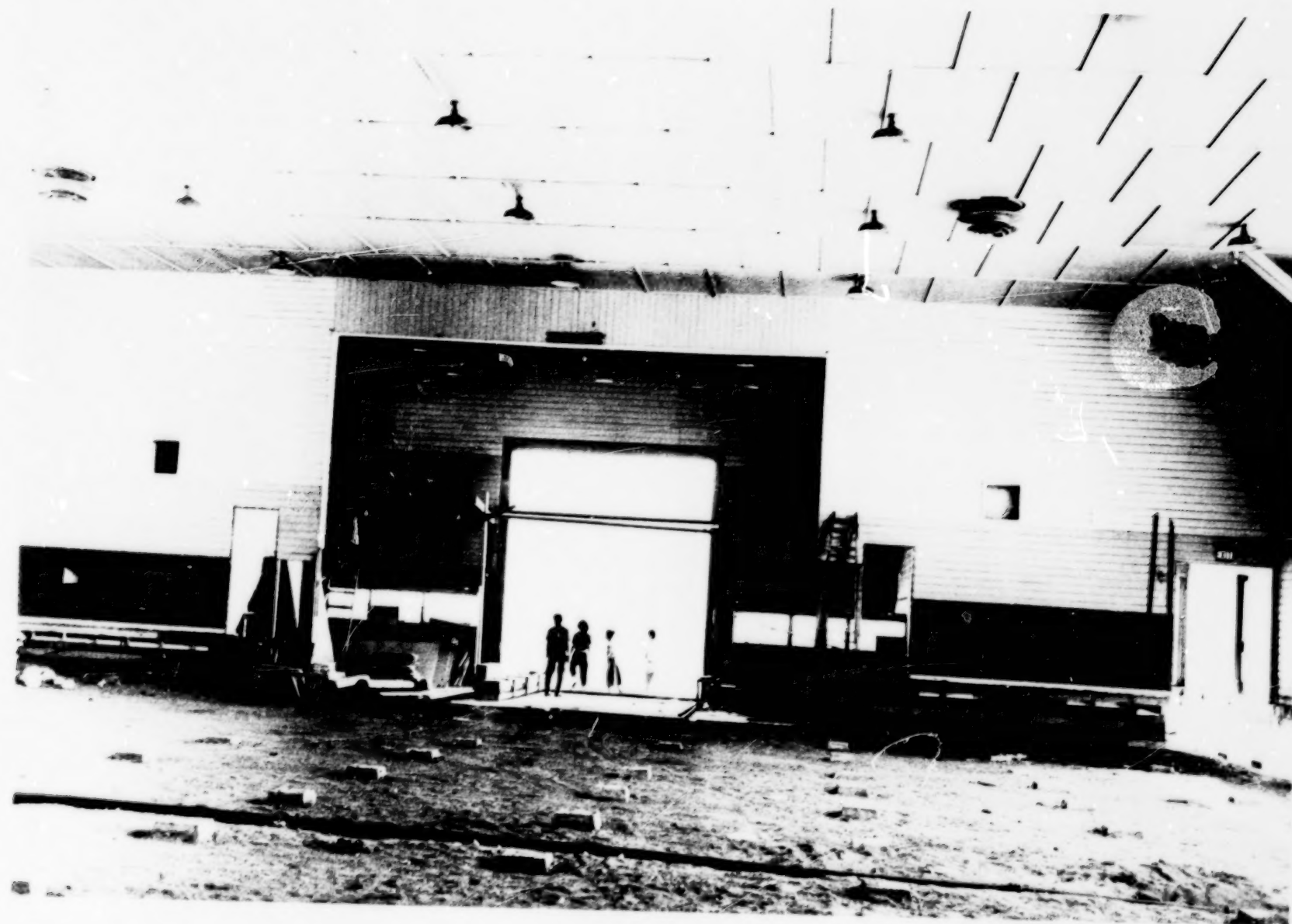


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Photo 36. After removal of the south wing by the VFW, Inyo County modified the auditorium building for use as a maintenance facility. This view, probably mid- to late-1954, shows that the stage has been removed and a vehicle access opening constructed in the east exterior wall. The windows that were originally in the space beneath the stage had not yet been removed. The auditorium-gymnasium floor has also been removed. The concrete pads which had provided support for the floor framing were used to fill in spaces between framing and footings at the perimeter of this space before earth fill and a concrete slab were installed. This new floor level is lower than the original floor surface leaving the original floor level and base trim position still visible. Some of the original wood flooring was used on new walls in the former stage space. Toyo Miyatake Collection, No. 87-F, courtesy Archie A. Miyatake, San Gabriel, California.



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HISTORIC PHOTOGRAPHS

Photo 37. West (main) entrance of the auditorium. This view shows that a small pine tree had been planted on each side of the entrance walks, although they are still small so this photo may have been taken about the time the camp was closed, late 1945, or sometime later. The entryway had also not yet been enclosed. Eastern California Museum Collection, MERR 8.

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HISTORIC PHOTOGRAPHS

Photo 38. View to the north with the front entrance features and west end of the auditorium-gymnasium building. Barracks Block 13 is just north of the auditorium. The Sierra Nevada mountains are in the background. There are no other buildings visible but the steps at the southwest corner of the building are visible at the extreme right, so this photo was probably taken between 1947 and 1954, most likely in the later part of that period as evidenced by the growth of the two pine trees. The west entrance is unenclosed, indicating that the enclosure was possibly constructed after 1954. Eastern California Museum Collection, NOM 47, 94.80.10a.



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PHYSICAL DESCRIPTION AND ANALYSIS

PHYSICAL DESCRIPTION AND ANALYSIS

SITE

The entrance to the site from highway U.S. 395 is to the east of the building. In the GMP, visitor parking is proposed to the east of the building. An interim plan of operation is under development in order to open the park to visitors. Aspects that may differ between the interim and ultimate (GMP) plan recommendations include entrance to the park, visitor flow and directions. The historic entrance to the building is on the west side, opposite the park entrance and proposed visitor parking. Parking and circulation around and into the building needs to be addressed. Design of the parking as well as restoration of landscape features in the building's vicinity will be important for both interim and ultimate use.

Photographs taken in 1944 and 1945 show parts of the building and surrounding site from shortly after the September 1944 completion of the building and into the next year. These photos indicate that the block which the building occupied was barren ground and the only site development and landscaping was the approach to the west main entrance. A wide concrete sidewalk had two planting beds bordered with concrete curbs and with a flag pole between them. This configuration was aligned with the center of the main entrance. Various photos show these beds had been planted with flowers. Still later a view toward the southwest from just outside the entrance shows that shrubs bordering the walk had been put in as well as a pine sapling on each side of the walk near the entrance. These trees are seen in late 1940s to early 1950s photos as having grown to perhaps twelve to fifteen feet in height.

The trees and plantings no longer exist, nor does the curb around the planting beds or the flagpole. The concrete walk, or at least most of it, still exists but sections of it are broken and the west end is buried under sand and gravel.

ARCHITECTURAL DESCRIPTION AND ANALYSIS

Character Defining Features

Exterior.

- Central gambrel roofed auditorium/gymnasium element with projecting two-story entrance element at west elevation and single story shed roofed "wings" on both north and south sides. South wing extended east 40'-9" beyond east wall of main structure
- V-groove shiplap siding, horizontal except vertical on main west wall and first story of west entrance.
- Exterior doors - wood, two panel.
- Windows - four-light fixed and awning:
 - On north and south sides of gymnasium above wings - bank of units three vertically by 16 horizontally.
 - Rows of single units along north and south exterior walls of wings.
 - Single units or groups of three units at other locations.

Interior.

- Main auditorium/gymnasium open space; ceiling of four foot by eight foot panels with 1x2 battens over joints, walls finished with painted V-groove horizontal shiplap, (historic) floor of 1x4 tongue and groove Douglas Fir, clear varnish finish, and the stage at the center of the east wall. The ceiling finish appears to have been a flat white which was actually the factory primer on the fiber board panels. The wall paint scheme appears to have been a dark brown wainscot (to 5 courses = 50"), a medium beige (to 10 courses = 100") and then a light beige to the ceiling. The stage ceiling and walls were similar to the assembly room; some activities were held before the stage curtains were installed.
- Industrial style painted metal pendant reflector light fixtures in auditorium/gym, with wire guards, in a 5 by 7 grid.
- Four suspended fan units in the auditorium/gym.
- Ceiling finishes in the other spaces consisted of fiber board panels similar to the auditorium, painted or unpainted shiplap boards or gypsum board.
- Wall finishes in the other spaces consisted of painted V-groove siding similar to the auditorium, painted or unpainted shiplap boards, painted gypsum board, or in some cases no finish was applied to the framing.
- Floors in the other spaces were primarily 1x4 t&g wood or concrete.
- Interior doors – (historically) predominantly wood two-panel.
- Auditorium seating – wooden benches.
- Window coverings – valence and side panels of a material probably similar to the stage curtains and black-out curtains. Wooden cleats (most still exist) were screwed to the sides of columns to secure the pull cords for the black-out curtains.

Exterior Description and Analysis

Roofing System. The roof form of the main auditorium-gymnasium space is a low-pitched gambrel formed by the roof trusses. The wings, west entrance and stage sections have low-pitched shed roofs. Roof sheathing consists of 1x6 shiplap (5-inch exposure). On the main auditorium roof, the sheathing was installed perpendicular to the purlins (that is, parallel to the trusses).⁷¹ The existing roofing is a mineral surfaced roll roofing, reportedly installed by the county (date unknown). The type of original roofing is difficult to discern from the historic photographs, but it was probably an asphaltic roll roofing. In fact, it was described as black mineral-surfaced split-sheet roll roofing (3 feet by 36 foot rolls, 116 pounds per roll), "mopped on with hot asphalt."⁷² The asphalt bond coat occasionally leaked through the sheathing board joints, observable on the underside from the attic. There are no visible nail penetrations when the roof sheathing is inspected from the underside in the attic so the roofing may not have been nailed in addition to the asphalt mopping as indicated in the proposed building material list. It is possible that the original roofing still exists under the later application.

⁷¹ See the related information in the historic data section of this report. The 1946 War Relocation Authority report (Appendix B) described the roof sheathing (sheeting) as laid diagonally; in fact it was laid perpendicular to the purlins.

⁷² See the 1942 material list for the building as proposed, Appendix A, and the 1946 report, Appendix B.

There are occasional water stains on roof sheathing and framing indicating some past leakage, but no deterioration was observed. Inspection along the eaves is difficult because of the low pitch of the roof and no crawlway surface. If deterioration exists it is likely to be found along the eaves, which are susceptible to deterioration because of overflowing gutters or damage to roofing or eave enclosure. Flashings are probably from more than the most recent roofing effort. Gutters and downspouts at the main roof are reported to have been installed at the time of the last roofing application. Gutters and downspouts do not show in historic photographs.

Exterior Walls and Siding. The exterior walls are wood frame construction with diagonal 1x6 board sheathing. Most of the building is finished with painted horizontal wood siding except for the main west wall and the ground level of the main west entrance, which have vertical siding. This exterior siding consists of both horizontal and vertical "V" groove Douglas Fir wood siding, 3/4 inches thick with a 5-inch exposure. On the south elevation, the lower portion of the wall that was originally the interior wall within the south wing has cedar siding which was used for a majority of the interior finish. For the most part, the siding is in poor condition, having received few paint coatings since the structure was constructed. Current efforts to preserve the siding using a new weathered wood primer look promising. This work was done under a recent contract which included all of the exterior except the west side of the building. Areas of severely deteriorated siding, mostly on the south elevation, were replaced with cedar, and all repainted. The west elevation will be treated separately. The siding there is in such deteriorated condition that it can't be preserved without having an adverse effect on the structure's historic appearance.

The west entrance configuration has been altered. The original entryway was open with two posts that divided the opening into thirds. The flanking enclosed end portions of the ground level entrance structure were the stairways to the projection rooms above. The stairs and projection rooms still exist. At a later time, at least by ca. 1954, this entryway was enclosed and a double door installed in the center and a window in each of the flanking sections. The original three double entry doorways in the main west wall of the assembly room still exist but the doors were removed. It appears that one of the original doors was installed in the in-fill wall.

Windows. The historic windows have been modified little since their installation. They are remarkably simple and consistent in detail on all elevations of the structure, consisting of single and multiple configurations of a single 4 light wood sash that is 1-3/4 inches thick, 4 feet wide by 3 feet 3 inches high, except on the north wing and in the east wall they are approximately 2 feet 3 inches in height.

In single and selected alternating first-course locations when ganged, these sashes open awning style where the top rail of the sash is set with hardware into a grooved wood slot and allowed to slide while simultaneously pivoting. When open, it appears they were held in place by the mere friction of the hardware gliding in the slotted wood stop (see drawing H11). Fixed sashes had no hardware and appeared to be face-nailed. No flashing or sealant was visible, nor did they appear to be used when the windows were installed. Furthermore, when the sashes were glazed historically, the glass panes were not set into putty, instead they were installed against the bare wood of the sash. The bottom rail of the sash is not shaped to fit (seat) against the sill accurately and may have been designed purposely as a drip.

PHYSICAL DESCRIPTION AND ANALYSIS

In a damper climate, the lack of these appropriate flashing details (particularly at vertical joints between sashes), sealant, and maintenance would have likely left the windows in a far more deteriorated condition in a shorter period of time.

The actual condition of the majority of the sash units on the north and south clerestories (where there are three courses of sash) is very poor, and in their current state they provide only limited protection from wind-driven rain. The rails and stiles are severely weathered and warped, and most of the glazing putty has broken down, the glass points rusted, the glass panes cracked, broken, and missing. A number of these sash units have been stockpiled inside the building.

Most of the windows of the north wing have a grid of steel bars applied to the exterior for security reasons, probably installed after 1954. Because visual inspection of these window sash was impaired by the security grilles, it is difficult to assess their condition, or what kind of damage may have been caused by the installation of the security grilles.

Most of the window units have severely deteriorated wood on the exterior surfaces and many are warped. The wood is deteriorated and warped because of paint deterioration and consequent exposure to hot sun, ultraviolet degradation, wind, rain and snow.

Doors. The historic doors are wood rail, stile, and panel construction. These doors, interior as well as exterior, were of unusually lightweight construction with 1/4 inch plywood panels (primary exterior doors appear to have been glazed in the upper panels) and no more than 1-1/2 inch thick rails and stiles. Because of this design, few of the exterior doors have survived the ravages of time. Vulnerable to severe weather, rough use, and repeated break-ins, most have been replaced by vandal resistant contemporary doors of solid wood or steel. Two exceptions are at exterior exit locations (room 106 and hall 113) where components of historic doors (some likely interior) and their black-metal panic hardware are still extant.

South Wing. The original south wing was described as containing toilets, dressing rooms, lockers and offices, similar to the north wing, but in addition the extension to the east contained a health unit.⁷³ The exterior design of the south wing was a mirror image of the north wing, with the exception of the health unit extension. During the period that the VFW used the building, some doorways were added in the south wall of the assembly room leading to spaces in the wing. After the wing was removed, ca. 1953-54, most of the original and added doorways were removed. Then a vehicle doorway was added at the west end of the south wall (at the southwest corner of the assembly room).

Interior Description and Analysis

Attic. Wood joists between the bottom chords of the roof trusses, with blocking at mid-span, provide the nailing grid for the panels of the auditorium-gymnasium ceiling. The bottom of the joists are flush with the bottom of the truss chords. The top surface of the ceiling panels has a considerable layer of dust blown into the attic over the years through the louvres at the ends of the attic. Before removal of ceiling material, this dust needs to be vacuumed out.

⁷³See the historic data section and the 1946 report, Appendix B.

Ceiling Materials and Finishes. The majority of the ceilings in the building were historically finished with 4 foot by 8 foot fiberboard panels with 3/4" by 1-1/2" wood battens covering the joints. The ceilings of the gym/assembly room and some rooms of the north wing are of this fiber composition board known as "Celotex", "Firtex," "beaverboard" or various other brand or generic names, listed only as insulation board in the 1942 proposed construction material list and "fibre" board in the 1946 report. It is one-half inch thick and had a white factory prime coat. No finish paint coat was added. This is a flammable material and should be removed and replaced. It is also sagging and very dirty and in some areas broken and missing.

Ceilings in some rooms in the building were finished with shiplap boards (painted and unpainted) or with 3/8" gypsum board (see finish schedule).

Wall Materials and Finishes. The majority of the historic interior walls are finished with painted horizontal "V" groove siding. In some rooms shiplap boards were used or 3/8" gypsum board (see finish schedule). Most of the non-historic wall in-fills have been constructed using remnants salvaged from the demolition of the historic auditorium/gymnasium floor.

Interior Paint Scheme. The historic paint colors and schemes are visible in many locations where items have been removed from the walls. In the auditorium/gym a light beige color is visible where the historic baseboards were removed; this was probably the base color of the primer. A dark brown finish color was used on the first 10 siding courses (to approximately 50-inches above the floor), medium beige the next 10 siding courses (to 100-inches), and light beige the rest of the way up to the ceiling line. These colors are visible in other parts of the building. After ca. 1954, most of the interior was painted medium gray.

Finish Floors. The original floor of the gymnasium/assembly room was a wooden gynasium floor system. Flooring was of 1x4 tongue and groove (3-1/4 inch exposure) Douglas fir, varnished. The framing was supported on a grid of concrete pads. This was removed and replaced with a concrete slab, ca. 1954, when the building became a maintenance facility. Portions of the wood floor were used to fill in part of the original stage opening. The existing concrete floor is below the level of the original wood floor, and remnants of the original floor can be seen at the perimeter of the room.

The historic floors that escaped demolition are primarily in the north wing. They also consist of 1x4 tongue and groove (3-1/4 inch exposure) vertical grain Douglas Fir strip flooring laid over diagonal 1 x 6 shiplap subflooring on 2 x 6 floor joists.

In historically wet locations there are thin concrete slabs poured directly over the 1 x 6 subfloor. In general the floor system of the north wing appears to be under-designed, even by residential standards, as they deflect excessively under the live load of one individual. It seems likely that the auditorium/gym floor would have been of similar construction but historic documentation indicates that this floor system was supposedly designed for a loading of 100 pounds per square foot.⁷⁴

Interior Doors. Some of the historic interior doors are extant, some have been modified, some are missing and others have been relocated or replaced. With some exceptions, interior doors

⁷⁴See historic data.

were also wood two panel, without glazing. Most extant historic doors need repair. Non-historic, badly damaged and missing doors will need to be replaced with new replicating the historic design.

Major Modifications from the Historic Period

Major modifications made were:

- Enclosure of main entrance – probably after 1954, but possibly between 1947 and 1954.
- Removal of wood gymnasium floor, installation of concrete slab floor – ca. 1954.
- Removal of stage and addition of vehicle access opening, east wall – ca. 1954.
- Removal of south wing – ca. 1953-54.
- Doorway modifications in south wall of gymnasium – additional doorways added between 1947 and 1953; various doorways removed or added ca. 1954 or later.

Enclosure of the main entrance at the west end of the building appears to have been accomplished with little modification of the original opening. The siding surrounding the opening, both exterior and interior, remains in place. The two original posts may still exist within the in-fill wall. The wall finishes within the entryway, ticket booth and stairwell enclosures remain intact. The original three double entrance doors and their hardware were removed, but the light fixtures above the doorways still exist.

The main floor of the auditorium is currently a concrete slab that was installed by the county (see historic photo 36) when they adapted the structure as a maintenance garage (ca. 1954). In order to satisfy this new function, major modifications were also made to the auditorium's structure so that it could accommodate heavy equipment.

At the east elevation, which was the back wall of the original stage, a 14 foot wide by 15 foot high opening was created by removing the exterior wall and stage floor framing. This required demolition of the stage's east wall down to the finish grade. There also was a double door here that provided access from the exterior to the space under the stage (historic photo 7).. Additionally, there is physical evidence that another original double door opening that would have been an exit at the southeast corner of the building was removed (at the end of Hall 121). Currently the opening is covered with siding.

In addition to the removal of the original stage floor (historic photo 36), its two flanking stair wells were also razed. Paint ghosts of the stairs are visible in basement rooms 118 and 119. In this same historic photograph, the wood gym/auditorium floor has been removed along with flooring at the same elevation in Hall 121. The concrete footings are still in evidence in this photo, but current physical investigation indicates that many of them, if not all, were relocated and stacked with boulders to create a retaining wall for the slab fill around the perimeter of the gymnasium space. The entire gym/auditorium (123), the hall at the southeast corner (121), and a room of undetermined use at the west end of the north wing (106), were all back-filled and a concrete slab poured wall-to-wall.

Concrete ramps were poured in a number of locations where a difference in elevation between the new slab and earlier wood and concrete finish floors had to be accommodated. The largest was poured in room 118, the basement beneath the central 1/3 of the stage that was removed. A

large metal roll-up door was installed on the east auditorium wall, transforming the stage space into a two story entry alcove that has been open to the elements ever since this modification was made. Other concrete ramps installed were at the northeast corner of the gym/auditorium slab to the wood floor of Hall 113, from the gym/auditorium slab to historic basement slabs (Rooms 116 and 119), and from the auditorium/gym slab to the historic wood floor in Hall 107.

Evidence of the wood auditorium/gym floor being employed as wall sheathing can be seen on the in-fill of the stage opening at the auditorium/gym east wall. From basement rooms 116 and 119, the varnished floor boards can be seen on the east side of this wall which still have their painted red and black game markings. The north and south walls of the vehicle entry 118 were created in a similar manner with historic flooring used as wall sheathing.

By comparing photos from the historic period with photos when the south wing was removed, the various changes in doorways in the south wall of the auditorium can be seen. (Also see the existing conditions drawings in this report). At the west main entrance, a wall was built to enclose the originally open entry. One central double door was installed, flanked on both sides with a set of windows. The three original sets of double entry doors were removed.

Hazardous Materials

Removal of buried fuel tanks and contaminated soil was accomplished by the county before National Park Service ownership of the building. There was a hydraulic vehicle lift in the floor of the auditorium/gym which was removed and a concrete slab installed at that location. Square concrete slabs were also poured to fill footing holes after removal of an overhead lift. Also the surface of the interior concrete slab was removed in areas where oil had accumulated from vehicle maintenance operations.

An asbestos survey and abatement effort was accomplished in 1996. Abatement was reported to have been completed on October 9, 1996.⁷⁵ The material found and consequently removed was an asbestos containing wall and ceiling board historically installed for fireproofing in the projection booth rooms, in furnace room spaces, around furnace vent flues and in a room later used for welding.

A lead-based paint survey was conducted in 1997. Almost all of both exterior and interior finishes tested contain lead.⁷⁶ The soil within 10 to 12 feet of the building also contains lead accumulated from weathering and paint chips from the building walls. All construction and maintenance work must be conducted in accordance with federal and state regulations. Where historic materials can be preserved, new paint can be used to provide encapsulation.

⁷⁵ Project Close Out Report. Death Valley (Scotty's Castle) and Manzanar. CAL Inc., Vacaville, California. November 22, 1996.

⁷⁶ Lead-Based Paint Survey, conducted by Cal Inc. Vacaville, California, contract order No. 1443PX8000-97-117, April 14, 1997.

PHYSICAL DESCRIPTION AND ANALYSIS

Pest Control. An inspection for pests, and some control and decontamination was undertaken in 1995, also before the building was transferred to the NPS. The problems identified, along with proposed means of control and decontamination, were rodents (rats and mice) associated with the Hantavirus, bees, subterranean termites and owls. Of particular concern was the rodent infestations around and in the building, which included deer mice, a primary host of the Hantavirus. Bees were found in the walls of the building. Termite damage was found in wood members near or having soil contact. Barn Owls had apparently gained access through holes to the ceiling spaces above the former stage, which now is essentially outdoors.⁷⁷

The rodent problem was a major concern. Removal and decontamination was reported underway in October of 1995. Owl nesting houses were provided outside the building. Nesting sites in the former stage ceiling and the damaged ceiling panels which allowed the birds access to the ceiling spaces were removed. These actions are reported to have accomplished a successful relocation.

STRUCTURAL SYSTEMS ANALYSIS

Description of Structural Systems

The entire building is wood framed. The lumber used throughout the building appears to have been good quality. For example, visible stud framing in the upper portions of the stage end of the building exhibits grading stamps showing select structural grade rated at 1200 psi. Much of the wood is stamped as being Douglas Fir. Most of the visible framing is in good condition, but termite damage has been identified in the crawl space of the north wing where framing is in contact with soil or concrete.⁷⁸ The individual components of the building are described below.

Gravity Load Resisting System.

Roof Framing -- The roof is a low-pitched gambrel formed by Pratt type trusses at 16-feet on center that span the full width of the auditorium. The trusses are constructed from 2-inch dimension lumber, and all joints are bolted with split-ring connectors. The top chord, bottom chord, and some of the web members consist of multiple 2x members--either doubled or tripled, depending on the location. Inter-truss 2x6 cross bracing occurs along the longitudinal centerline of the building. Diagonal knee braces connect each truss to its supporting column. The trusses support 2x10 (1-1/2"x9") purlins perpendicular to, and framed over the top of, the trusses at 24-inches on center. Full 2x10 blocking between purlins occurs at each truss and at mid-span of the purlin. Roof sheathing consists of 1x6 shiplap boards (5-inch exposure) perpendicular to the purlins (parallel to the trusses). No deterioration or failures of the roof framing were observed. Longitudinal cracks were observed, however, in the top chords of the trusses at the connection where the knee brace connects.

⁷⁷Letter, to Superintendent, Manzanar NHS from Pestmaster Services, Bishop, CA, August 23, 1995; also letter to Western Region Office, NPS, from Pestmaster Services, Bishop, CA, October 9, 1995.

⁷⁸See footnote 10.

The roof framing at the north and east wings consists of straight 1x sheathing on 2x12 roof rafters at 24" on center. In the west wing, the roof framing consists of straight 1x sheathing on 2x8 rafters at 24" on center.

Attic Framing — Attic framing consists of 2x6 (1-1/2"x5-3/8") joists at 24 inches on center spanning between the bottom chords of the trusses. The joists are notched to rest on 2x3 (1-5/8"x2-1/2") ledgers attached to the bottom chords of the trusses. The bottom edge of both the ledgers and the joists are flush with the bottom of the truss chord. The joists are blocked at mid-span with 2x4s laid flat that serve the dual purpose of also providing a nailer for the ceiling panels.

Wall Framing — The exterior walls are 2x4 or 2x6 (depending on the location) stud walls with 1x6 board sheathing. At all "exterior" walls, the sheathing is diagonal. At all "interior" walls, there is no sheathing; the wall finishes are applied directly to the studs. In this context, "exterior" is defined as walls or portions of walls visible from the exterior of the building, and "interior" is defined as all other walls. The implication of these definitions is that the portions of the walls of the auditorium space that are above or outside the adjacent building wings have diagonal sheathing, but the sheathing terminates at the point where the wing begins and the wall becomes part of the interior of the building. All of the truly exterior walls of the building wings have diagonal sheathing.

There are large areas of windows in the north and south walls of the auditorium and a long stretch of shallow windows in the north wing. There are also large door openings in the east wall and in the south wall near the west corner.

The trusses are supported by built-up columns located at the perimeter of the auditorium. The columns generally consist of three 2-1/2"x14-1/2" and two 1-1/2"x 14-1/2" members, bolted together with six pairs of 5/8"-diameter bolts. These columns are exposed at the interior of the north and south walls of the auditorium/gymnasium space. The truss-to-column connections consist of 1/4-inch steel gusset plates bolted to each side of the connection. The bottom portion of these plates is visible from the interior of the auditorium. Diagonal knee braces connect each truss to its supporting columns. The braces, consisting of a 2x6 at each face of the column, are bolted to the column and to the top and bottom chords of the truss. These braces are visible in the gymnasium below the ceiling level.

In three locations at the south wall of the auditorium/gymnasium, the bottoms of the columns were found to be considerably deteriorated from a combination of termite and rot damage (see photos 13 and 14, Appendix J), resulting in a lack of positive bearing between the column and the footing. In one case, there exists a 6" air gap between the bottom of the column and the top of the pier. In another case, the historic pier was capped with additional concrete, possibly by the county, to fill in the gap between the rotted column base and the pier. The column has continued to disintegrate, however. It should be noted that these columns were historically protected by the south wing that was removed ca. 1954. Once it was removed, they were exposed to the elements, and, in one case, the close proximity of a hose bib.

Floors — The floor of the auditorium is a slab-on-grade. This was installed ca. 1954 when the building became a maintenance facility.

The floors in the east wing consist of diagonal 1x sheathing on 2x joists. The joists in the remaining stage area are at 12" on center.

The upper floor of the west wing (the Projection Room) has 2" of concrete on wood subflooring. The lower floor is a concrete slab-on-grade and appears to be the original floor.

A crawl space extends under most of the north wing. The floor framing consists of 1x diagonal sheathing on 2x6 (1-5/8"x5-3/8") joists at 16" on center. The joists span between the north wall of the auditorium and the north wall of the north wing. A 5-3/8"x9" beam running longitudinally down the centerline of the wing provides an intermediate line of support. The beams, both at the centerline and the perimeter, are supported by wood posts (two 3-1/2"x5-5/8") resting on 2x plates sitting on 28"x28" concrete footings. There are no visible connections between the joists, beams, posts, and footings. The floor in the restroom area has a thin concrete slab poured over the top of the wood-framed floor. The wood-framed floor was removed in the north wing west of the restroom, and a concrete slab-on-grade was installed in its place. A skirt surrounds the north wing below the floor framing consisting of vertical 1x siding spanning between the bottom of the beam and a 2x installed between the posts just above the concrete footings. The floor framing in the north wing should be investigated further for rot or insect damage, as the floor deflects noticeably under the load of only one individual.

Foundations — As previously stated, the auditorium floor is a slab-on-grade, as is the lower floor of the west wing and a portion of the north wing. The west wall of the auditorium is supported by 28"x28" footings at approximately 8 feet on center. The top of footing elevation is about 16 inches below the slab-on-grade elevation. The east wall of the auditorium is supported by concrete grade beams. The bottom portion of the stud wall is below the auditorium slab-on-grade and is, therefore, in contact with concrete and soil on its west face.

The north wall of the auditorium is supported by wood beams on wood posts on concrete footings. It is assumed that historically the south wall was supported in a similar fashion as the north wall. Presently, however, a concrete grade beam exists along the bottom of the wall. Soil was placed against this grade beam such that the bottoms of the columns supporting the trusses were below grade. The columns supporting the trusses bear on tapered concrete piers. There is no evidence that the columns are anchored to the piers.

At the east wing, the exterior wall is supported by a concrete foundation wall visible in the low storage rooms. The exterior grade is near or in some places above the top of this concrete wall, placing the wood wall in contact with soil. It is unknown whether the concrete supporting the wall is a grade beam or stem wall and footing.

At the north wing, the interior and perimeter beams are supported by wood posts on concrete footings. The footings along the perimeter are visible from the exterior.

The depths of all foundation elements are unknown.

Lateral Load Resisting Systems. A copy of the report "FEMA 178/June 1992 Seismic Evaluation of the Manzanar Auditorium Building" (MARTIN/MARTIN Consulting Engineers, December 1998) is included in Appendix J. This report includes descriptions of the lateral load

resisting system, its deficiencies, and rehabilitation recommendations. The recommendations intend to strengthen the building to the point of being life-safe, meaning that occupants will be able to escape the building during a severe earthquake but that the building itself may experience severe damage, even to the point of not being salvageable. Further consideration should be given to determine if additional strengthening beyond a life-safety level would be appropriate and feasible.

Structural Analysis and Findings

Loads. The following loads--derived from the Uniform Building Code, 1997 edition, unless otherwise noted--were used in the analysis of the building components:

Live Loads		
Roof Live Load	20 psf	
Snow Load, Pg	30 psf	(from Public Works Dept., Inyo County)
Snow Load, Pf	18 psf	
Attic	10 psf	
Floor Live Load	100 psf	
Seismic - Zone 4		
Wind - 70 mph, Exposure C		
Dead Loads		
Roof	10 psf	
Attic/Ceiling	10 psf	
Floor	10 psf	

Gravity Load Deficiencies and Recommendations.

Roof Framing — An analysis was run to determine the stresses in all of the truss members. The truss top and bottom chord members are significantly overstressed, while the web members are generally acceptable. Also, several of the bolted truss connections are severely overstressed. The trusses will likely require the addition of steel elements along both sides of the top and bottom chords with new steel gusset plates at the panel point connections to bring them up to the design load capacity. The cracked top chord members could be repaired with new metal straps extending along the diagonal web member, around the top of the top chord, and back down the opposite side of the web member, designed to transfer all of the tension in the diagonal member. (See Figure 8, Appendix J.)

The capacity of the roof purlins is adequate for the design load, but the ceiling joists are overstressed and will need to be upgraded by sistering a new joist along one side of each existing joist.

Wall Framing — The built-up columns have sufficient capacity in their current configuration. The rot at the bottoms of the columns needs to be repaired, however. The damaged wood should be removed, and either new wood can be spliced to the existing columns or new concrete pedestals can be cast between the bottom of the column and the existing footings.

Floor Framing — The floor framing in the north wing should be investigated further for rot or insect damage, and analyzed for its load carrying capacity.

Foundations -- The foundations may need to be supplemented with additional concrete to raise the elevation in order to get the wood out of contact with the soil.

Seismic Deficiencies and Recommendations. Complete descriptions of the deficiencies and rehabilitation recommendations are included in the report contained in Appendix J. A summary of the recommendations is as follows:

1. *Wood Decay* - The decay of the wood columns needs to be repaired. (See Figure 7, Appendix J.) On the south, the repair will be relatively simple, because the columns are easily accessible. On the north, east, and west walls, portions of the concrete slab-on-grade will have to be removed so that new portions of columns can be spliced in or so that the top of footing elevation can be raised to elevate the column bases from being in contact with the soil.
2. *Inadequate Shear Walls* - The lack of shear walls is a serious deficiency. The lack of adequate sheathing and the presence of large and numerous door and window openings render the existing walls severely overstressed. Certain portions of the walls should be designed as plywood shear walls or have new steel rod diagonal bracing installed. New concrete grade beams or enlarged footings will be required at the bases of these walls. The suggested locations for these shear walls are shown in Figures 2, 4, 5, 6, and 7, Appendix J.
3. *Unbraced Cripple Walls at North Wing Crawl Space* - The posts in the crawl space need to be more adequately braced. The added shear walls or diagonal bracing in the north wing can be designed to also brace the crawl space.
4. *Inadequate Roof Diaphragms* - The inadequate straight 1x roof sheathing could be corrected with an engineered plywood diaphragm installed over the 1x straight sheathing. An alternate solution is to locate the diaphragm at the ceiling level by augmenting the ceiling bracing to act as a diaphragm. This solution would also require the installation of additional bracing between the roof and the ceiling, but it would spare having to remove the existing roofing.
5. *Lack of Diaphragm Chords and Struts* - The discontinuous 2x wall top plates are prevented from acting as a diaphragm chord. Light gauge steel straps should be installed across the discontinuities (See Figure 3, Appendix J.) The 2x top wall plates can function as drag struts, provided they are adequately sized and connected.
6. *Inadequate Connections and Ties* - Inadequate connections between structural components can be remedied for each specific deficiency.
 - The roof diaphragm should be connected to the diaphragm chords and drag struts when the sheathing is installed, or with appropriate connectors to the alternative roof-ceiling bracing system.
 - The beam-to-post and post-to-foundation connections in the north wing should be improved with light-gauge connectors fastened to the wood and anchor bolted to the concrete.

- The north wing footings may need to be connected, if required by further analysis. This could be done with either continuous steel members anchor bolted to the footings or with a slab-on-grade installed around and doweled to the footings.
7. No Ceiling Bracing - Additional ceiling diaphragm bracing is needed because of the 80-foot ceiling diaphragm span and could be supplied by one of the following: 2x diagonals installed in the horizontal plane at the ceiling level; plywood added in alternate bays of the ceiling joists; or additional 2x cross bracing between the trusses (similar to what presently occurs at the building centerline). Either of the first two solutions could be designed to act as the primary diaphragm, as previously discussed.

MECHANICAL SYSTEMS ANALYSIS

Purpose

The Manzanar Auditorium building is planned to be rehabilitated and adaptively reused for Manzanar National Historic Site interpretive and administrative functions. Because the National Park Service will be a long-term owner and occupant of this structure, it is in the best interest of the Government that long-term operating costs are as low as practically possible. To keep operating costs at a minimum, it is essential that all potential mechanical systems and building envelope treatments considered for inclusion into future designs be analyzed with respect to these costs. Efforts should be made to reduce construction and operating costs as much as possible, while maintaining historical integrity, aesthetics, comfort, simplicity of operation, ease of maintenance, and sustainability, particularly low environmental impact.

This section describes, analyzes, and makes recommendations for proposed building envelope treatments, heating, ventilating, and air conditioning (HVAC), and plumbing systems in the Auditorium building at the Manzanar site.

Recommendations Summary

Building Envelope. Because of the substantial energy savings that will result, the walls, floors, and roofs of the building should be insulated as much as is practical as part of any rehabilitation work. Insulated glazing units are also recommended for implementation for the same reason. In addition to reducing energy consumption, insulating the building has the added benefits of reducing mechanical system sizes and increasing interior comfort levels. Although insulating the gym walls will result in even greater energy savings, it is not recommended to do so unless a suitable insulation methodology that does not require the removal or destruction of the interior finishes can be implemented.

Heating, Ventilating, and Air Conditioning System. The systems recommended for implementation as part of any rehabilitation work are as follows:

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- Single-stage evaporative coolers and hydronic (hot water) radiant floor heating system for the gym and stage areas, with a propane-fired makeup air unit for ventilation in the heating season.
- Air-cooled package air conditioners with hot water heating coils for the remaining spaces in the building to be conditioned.
- High efficiency propane-fired hot water boilers to provide hot water for the radiant floor heating system and the hot water coils associated with the package air conditioners.
- Toilet exhaust systems in all of the new restroom spaces.

Plumbing Systems. It is recommended that all of the piping in the building be replaced with new piping. New domestic water heaters should be provided as necessary. All new plumbing fixtures and fittings shall be water-conserving (low-flow) type.

Fire Protection Systems. It is recommended that portable fire extinguishers be installed in strategic locations throughout the building. When the south wing is reconstructed, it should be fully sprinklered, with its sprinkler system connected to the existing (1998) dry pipe sprinkler system in the Auditorium building.

Building Envelope

Historic Conditions. The existing Auditorium building was constructed in 1944 and is fairly typical of temporary military buildings built during this period. It is a wood frame structure, with single-glazed wood sash windows and little (if any) insulation in the walls and roofs. There is no insulation in any of the walls and the only roof that was insulated is the north wing roof. The north wing roof is insulated with 2 inches of "Kimsul" cellulose batt insulation that was installed as part of the original construction. It is assumed that the south wing roof was insulated in a similar manner.

It appears that the exterior of the building had light-colored walls during the historic period which would have helped with keeping the building cooler by reflecting more solar heat than they absorbed. However, it also appears that the roof was covered with black mineral cap asphaltic roll roofing which would have added a considerable amount of heat to the spaces below by absorbing more solar heat than it reflected.

Existing Conditions. Other than the modifications listed in the Architectural Analysis section of this document, vandalism, and the ravages of time, the building and building envelope remain much the same as they were when originally constructed in 1944. The major modifications that affect mechanical systems design in the building are as follows:

New Roof — The present roofing system consists of white mineral cap asphaltic roll roofing. This is a more desirable color of roofing material from a cooling standpoint since it reflects more solar heat than a comparable black roof would. If the existing roof is replaced at some point with a black roof to match the historic conditions, this will need to be taken into account in any new cooling systems designs.

Concrete Floor in Gym — When the building was converted to a vehicle maintenance facility, the original wood frame floor in the gym was removed and replaced with a concrete floor on fill. This floor represents not only additional thermal mass in the building, but also presents an opportunity to install a hydronic radiant floor heating system in the gym area.

Removal of the South Wing Structure — Reconstruction of the south wing will represent additional heating and cooling loads that would not presently be accounted for

Because it is a lightweight frame structure, the Auditorium building does not have a great deal of thermal mass. Thermal mass acts as a "heat battery". The mass absorbs and releases heat in the interior of the building, and acts to stabilize the temperatures inside the building. The less mass there is inside a building, the greater the interior temperature swings during the day; conversely, the more mass there is inside a building, the smaller the interior temperature swings during the day. Since this building has little mass to reduce interior swings during the day, the only reasonable option that can be implemented to reduce interior temperature swings and to reduce the size of the mechanical cooling and heating equipment is to add insulation to the building envelope.

Recommended Treatments. Because of the poor insulating qualities of the majority of the building envelope, insulation should be added to the building envelope. To accurately gauge the effects of treatments related to the building envelope, cooling and heating load calculations were performed for various alternatives as follows:

- Alternative 1 - Existing Building (with South Wing Added On), No Treatments
- Alternative 2 - Insulate Floors, Ceilings, and Walls (no insulation in gym walls)
- Alternative 3 - Insulate Floors, Ceilings, and Walls (with insulation in gym walls)
- Alternative 4 - Install Insulated Glazing (no insulation in gym walls)
- Alternative 5 - Install Insulated Glazing (with insulation in gym walls)

In all of the alternatives presented above, the south wing is added into the load calculations, fully insulated and provided with insulated glazing as it would be if reinstalled on the existing building. All of the alternatives are "additive", i.e., Alternative 3 adds insulation to the Alternative 2 case, Alternative 4 adds insulated glazing to the Alternative 2 case, etc.

ENVELOPE ALTERNATIVE NUMBER	BUILDING COOLING LOAD, ENVELOPE ONLY (TONS) ^a	BUILDING HEATING LOAD, ENVELOPE ONLY (MBH) ^b	BUILDING COOLING LOAD, WITH INTERNAL AND VENTILATION LOADS (TONS) ^a	BUILDING HEATING LOAD, WITH VENTILATION (MBH) ^b
1	20.3	443	53.5	677
2	14.1	335	44.6	565
3	13.2	291	43.4	521
4	12.6	240	42.3	470
5	11.7	224	41.4	454

^a1 Ton = 12,000 BTU (British Thermal Units) per hour cooling capacity

^b1 MBH = 1,000 BTU per hour

Alternative 2 vs. Alternative 1 — As can be seen from the numbers presented in the table above, the most marked reduction in cooling and heating loads occurs when the majority of the building is insulated (excluding the gym walls). Because this treatment results in the largest reduction of cooling and heating loads, it is recommended that as much insulation as possible be installed in the building walls (R11), ceilings (R30), and floors (R19) as part of any rehabilitation work. This will not only save energy, but will reduce mechanical equipment sizes necessary to properly condition the building and will increase occupant comfort.

Alternative 3 vs. Alternative 2 — Insulating the gym walls in addition to insulating the remainder of the building also results in reductions of cooling and heating loads, but not as great as the reductions resulting from the addition of insulation modeled in Alternative 2. Because the interior surfaces of the gym are in good condition and it would be difficult and expensive to remove the interior surfaces to add insulation, it is recommended that insulation not be added to the gym walls, unless some other method that does not require removal or destruction of the interior finishes (such as using blown-in insulation) can be implemented.

Alternative 4 vs. Alternative 2 — Adding insulated glazing reduces the heating loads by almost the same amount (approximately 100 MBH) as insulating the building does. However, the cooling loads are not reduced as dramatically. The reason for this is twofold. First, the temperature difference for conduction through the glass in the summer is not as great as it is in the winter, reducing the effect of the improvement in insulating qualities of the glass. Second, the shading coefficient for clear double glazing is 0.88 vs. 1.0 for clear single glazing. This represents only a 12 percent reduction in the solar gain into the building spaces. Given all of this, it is still recommended to add insulated glazing to the building as part of any rehabilitation work to reduce the heating load to save energy, reduce heating equipment sizes, and increase occupant comfort.

Alternative 5 vs. Alternative 4 — The discussion here is the same as that for Alternative 3 vs. Alternative 2.

Heating, Ventilating, and Air Conditioning

Historic Conditions. The Auditorium building was originally equipped with oil-fired forced air furnaces. The main gym space (Room 123) was heated with four furnaces, one in Room 104, one in Room 115, one in Room 120, and one in the south wing, directly across the gym from Room 104. Heat for the north wing was provided by another furnace in Room 104 and (probably) unit heaters in Rooms 110 and 111. Flue locations shown in the historic photographs and physical evidence inside the building support these locations. The flue locations shown in the historic photographs also indicate that the heating systems in the south wing were a mirror image of the ones in the north wing. Destratification of heated air in the high ceiling gym space (Room 123) was provided by four fan units located on the ceiling. These units were vertical projection unit heaters with no heating coils installed. No permanent heating systems appear to have been installed in any of the spaces in the east or west wings of the building.

No cooling systems, other than doors and operable windows, were provided in the original construction. Ventilation was provided by doors and operable windows in most of the areas of the building. Ventilation for the restrooms and shower rooms in the north and south wings was provided by what appear in the historic photographs to be roof-mounted gravity ventilators.

Existing Conditions All of the original furnaces and unit heaters have been removed from the building at some time in the past. Three of the four historic thermostats that controlled the furnaces for the gym (Room 123) are still in place; the thermostat that was located on the south wall is missing. Heating during the period that Inyo County used the building for a maintenance facility was provided by various gas-fired and electric appliances. High intensity radiant heaters are installed near the ceiling, mostly at the west end of the room, to provide spot heating. A horizontal projection unit heater is installed in Room 110. A through-the-wall room air conditioner provides heat (electric) in Room 111. Heat in Room 109 is provided by an electric wall heater. An electric unit heater is currently being added to Room 117 under the Package D164 construction contract. A 1,000 gallon propane storage tank, located near the northwest corner of the fenced enclosure surrounding the building, provides gas to all of the gas fired appliances. In addition to the space heating appliances, the propane tank also supplied gas to a heat treating oven that was located in Room 104.

Although the fuel oil tank(s) supplying the original furnaces have been removed, some of the piping that supplied the furnaces is still intact inside the building. One-fourth inch oil supply lines for the oil-fired furnaces and unit heaters are still visible in Rooms 104, 110, 111, 115, and 120. What appear to be two 1/2 inch oil lines penetrate the floor in Room 117; their function is unknown.

Evaporative coolers and window air conditioners were installed to provide cooling during the period that Inyo County used the building. Four large evaporative coolers were installed to provide cooling in the gym (Room 123). Two of the coolers that were mounted on the roof of the north wing have been removed because of structural safety concerns. The other two coolers located on the south and west sides of the building, are still in place. A through-the-wall air conditioner is installed in Room 111.

Recommended Treatments. To make the Auditorium building suitable for year-round park operations, modern HVAC systems will need to be installed to provide comfort conditions inside the building. Different types of HVAC systems and energy sources that may be suitable for use in this project are discussed below. These discussions outline features, advantages, and disadvantages of each type of system and are general in nature. Because of economics and/or considerations related to the building, there are several types of HVAC systems that were considered and rejected:

1. **Direct Resistance Electric Heating:** As far as being flexible and integrating with the building itself, direct resistance electric heating would be a good choice for this project. However, the operating costs would be excessive in the winter (both consumption and demand charges would be high). Also, the electrical service may not be able to handle a heating load of approximately 140 KW (this is the peak heating load with building envelope treatment Alternative 4) in addition to the other electrical loads in the building.

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2. **Fuel Oil Heating:** Fuel oil could be used to fire boilers or furnaces as was done historically, but presents some difficulties. First, fuel oil is not commonly used as a heating fuel in the Owens Valley area. The heating fuel of choice is propane (natural gas could be used, but is not presently available). Second, the use of fuel oil as a heating fuel requires a storage tank. Whether this tank is located above or below ground, it is required to have overfill spill prevention devices and secondary containment with leak monitoring. Underground fuel oil piping must have a secondary containment also.
3. **Air-to-Air Heat Pumps:** Air-to-air heat pumps are a more energy-efficient choice for heating than direct resistance electric heat. Another advantage is that cooling can be provided also with the same piece of equipment. The major drawback of air-to-air heat pumps is that the heating capacity drops off as the outside temperature decreases and the cooling capacity drops off as the outdoor temperature increases. At low temperatures (typically around 20 degrees F), the heating capacity drops off so much that the heat pump cannot produce enough heat energy to adequately heat the indoor spaces. At this point, a supplemental heat source (typically direct resistance electric heat) must be turned on to provide additional heat energy. In colder climates, icing of the outdoor air coil can occur, requiring additional energy to defrost the coils.
4. **Ground-Coupled Heat Pumps:** Although ground-coupled heat pumps are very energy efficient and would be a good choice for this project, there is a drawback in using them here. Because wells approximately 200 feet deep would need to be drilled to form the ground heat exchanger, they would likely penetrate into the water table below the site. The water rights for this water table are owned by Los Angeles Department of Water and Power (LADWP) and unless a variance were granted, drilling these wells would be prohibited.
5. **Solar Assist:** Because of the historic nature of this structure, any type of active solar system collectors mounted on the building proper will be unacceptable. Active solar panels could be mounted on a ground array, but adequate site space near the building may not be compatible with other site features such as parking and landscaped areas.

The major cooling and heating load is in the gym area, which (using building envelope Alternative 4) represents 53 percent of the total cooling load and 60 percent of the total heating load in the building. This being the case, and because it is the single largest space in the building, the gym is the one area of the building that should receive the most efficient cooling and heating systems to reduce energy consumption. To provide the most efficient cooling and heating possible, two systems in particular are being recommended for implementation in the gym: evaporative cooling and hydronic radiant floor heating.

Evaporative cooling is used extensively in desert climates and has one of the lowest operating costs of any type of cooling system. It is also frequently used to cool large spaces that would be uneconomical to cool in any other fashion. If the acceptable space cooling temperature in the gym can be raised from 75°F to 80°F, it will be practical to use single-stage evaporative coolers to cool the space. With the increased air quantities that are required with evaporative cooling, there will be good air motion through the space, contributing to a sense of cooling comfort by the occupants.

Two possible location options are available for the evaporative cooling units. One option is to locate the units in the attic above the gym and draw air in through the existing attic ventilation louvers. Supply ductwork would be provided in the attic to connect to new supply diffusers at the ceiling of the gym (consideration was given to reusing the historic fan units at the ceiling as supply air diffusers, but with the air quantities required, the historic fan units are too small and would be quite noisy). Support structures and catwalks would have to be provided to install and service the units in the attic. The other option is to locate the units in the third floor storage rooms flanking the stage (Rooms 301 and 302). Openings in the outside walls would have to be provided to install the units from the outside and to provide outside air to the units through louvers installed in the openings. Supply air would be introduced into the gym through grilles mounted high on the east wall. In both cases, relief air pathways would need to be provided for the evaporative coolers. The historic furnace air openings into the gym can function as relief air outlets. Plenums or ducts connecting the furnace air openings with exterior louvers or with the spaces under the north and south wings would need to be provided to complete the relief air pathways to the building exterior. The relief air openings will be provided with automatic dampers that will open when the evaporative coolers are running and will close when they are shut down. This eliminates the need to manually open and close doors or windows to create relief air routes for the evaporative coolers.

One of the drawbacks of using any type of forced air heating in a space with a high ceiling is that hot air will collect at the ceiling of the space, leaving the zone between the floor and 8 feet above the floor relatively cold. Also, with higher than normal temperature air in the upper part of the space, the temperature difference between the inside and outside of the building is increased, resulting in additional heat loss. Both of these issues were addressed historically in the Auditorium building by installing destratification fan units at the ceiling to force the warm air back down to the floor level where it was needed. To avoid hot air stratification problems, it is proposed that a hydronic (hot water) radiant floor heating system be implemented in the gym. This type of system puts the heat where it is needed: at the floor level where the occupants are. Because the main heating effect is radiant rather than convective, the air in the space is heated less than it would be with a forced air system. Even though the air temperature is less than it would be normally, the occupants feel comfortable because they are receiving most of the heat radiantly (in the same fashion that a person feels warmer on a cold day when the sun is shining). Since the air is not being heated directly, very little (if any) stratification occurs. Studies have shown that with radiant floor heating systems in spaces with high ceilings, the temperature difference between the air one foot above the floor and the air at the ceiling is in the range of 2°F. With a lower space temperature and little or no stratification, heating energy savings will be substantial compared to a conventional forced air heating system.

A radiant floor heating system can be incorporated into restoration work that is done to the floor in the gym. To increase the control responsiveness of the radiant floor and to mitigate heat loss out of the bottom and sides of the floor, it is recommended that rigid insulation be installed on top of the existing concrete floor slab under any new wooden floor that will be installed. The insulation can be channelled and the hot water piping (cross-linked polyethylene) for the radiant floor can be installed in the insulation channels directly below the wooden subfloor material. Heat for the radiant floor system will be provided by hot water boilers located in a boiler room located in the area under the reconstructed stage. Since it is directly connected to the gym area, the stage area can be cooled and heated by the evaporative coolers and radiant floor heating system serving the gym proper.

During the cooling season, ventilation for the gym and stage will be provided by the evaporative coolers. The controls can be configured such that during occupied hours, the evaporative cooler fans would run continuously and during unoccupied hours, the evaporative cooler fans would run only when the thermostat called for cooling. Because the outside air quantities that the evaporative coolers supply to the space are considerably larger than that required by ASHRAE 62-89, it is recommended that a separate ventilation system, sized only as large as need be for ventilation air, be provided in the gym for the heating season. This system would consist of a propane fired makeup air unit, located in the attic space above the gym. Although they were too small for the evaporative cooler supply air, the historic ceiling fan units in the gym are large enough to supply tempered ventilation air into the gym space. The heating ventilation unit would operate during occupied hours and would be shut down during unoccupied hours.

The other major areas of the building that need to be conditioned are the existing north wing, some of the rooms in the existing west wing (Rooms 201 and 202), some of the rooms in the existing east wing (Rooms 204, 205, 208, and 209), and the reconstructed south wing. Since it appears that these spaces will be primarily office, visitor contact, and support spaces, it is recommended that air-cooled packaged air conditioning units be implemented to provide cooling to these spaces for maximum comfort and temperature control. To preserve the historic scene on the exterior of the building as much as possible, each air conditioning unit should be equipped with centrifugal fan condensing sections so that the entire air conditioning unit can be located inside the building envelope. This eliminates having any type of air conditioning equipment visible outside the building, but necessitates the installation of louvers in the building walls for the condensing air to enter and exit through.

The air conditioning unit for the north wing and Rooms 204 and 205 can be located in a room in the space under the reconstructed stage. The air conditioning unit for the south wing and Rooms 208 and 209 can be located in a similar space. Condenser air for both of these units can be provided through louvers located in the historic window openings communicating with the space under the stage on the east face of the building. Supply and return air ductwork for the north and south wings can be routed in the crawlspaces under the wings, with floor mounted supply and return air grilles serving the spaces above. The air conditioning unit for the west wing can be located in Room 202, with the condenser air being provided through a louver located in the historic window opening in the same room. Ventilation air will be provided to all spaces by the air conditioning units per ASHRAE 62.

Heating for the spaces served by the packaged air conditioners will be provided by hot water heating coils at each unit. Hot water for the heating coils will be provided by the same boilers that supply heat to the radiant floor heat system. It is recommended that high efficiency propane-fired hot water boilers be implemented to further reduce heating energy consumption. High efficiency boilers will also allow greater design flexibility for flue routing and combustion air pathways.

A single 1,000 gallon propane tank is currently located near the northwest corner of the existing cyclone fence around the Auditorium building. This existing propane tank should be relocated to a location near the new utility building. Using the heating load calculated for envelope

¹ ASHRAE 62-89, *Ventilation for Acceptable Indoor Air Quality*

Alternative 4, it appears that a second 1,000 gallon tank will need to be added to meet the load. To avoid frequent refills, a third 1,000 gallon tank may be desirable to increase the propane storage capacity. New underground gas piping would be run from the propane tank farm location to the boiler room location in the building.

Toilet exhaust systems will be provided for all of the public and private restrooms in the building. Reconstructed gravity ventilators on the roofs of the north and south wings may be adapted to serve as toilet exhaust air outlets. In addition to installing new HVAC systems in the building, removal of existing heating and cooling equipment, and associated piping needs to be done as part of any rehabilitation project.

Plumbing Systems

Historic Conditions. The original domestic water system consisted of galvanized steel piping. Soil waste and vent piping in the building is cast iron, with galvanized steel being used for smaller diameter piping. Although there is evidence that domestic hot water was available during the historic period (hot water connections exist for the lavatories in Room 109), there is no evidence of the water heaters themselves.

Plumbing fixtures that were installed in the north wing restroom (Room 109) were 4 water closets, 3 urinals, and 4 lavatories. There was a mop sink installed in the janitor's closet (Room 108). The north wing also contained a shower room, but it is not known how many showers were installed in the shower room. It is assumed that the original south wing of the building had numbers and types of plumbing fixtures similar to the north wing.

Existing Conditions. The only functional plumbing fixtures remaining in the Auditorium building are one water closet, one urinal, and one lavatory in the north wing restroom (Room 109). All of the other historic plumbing fixtures have been removed at some time in the past. There is a small electric tank-type water heater located in Room 109 adjacent to the lavatory to provide hot water for hand washing. Most of the historic water and soil piping is extant in Room 109. The water and sewer services in the building are currently being supplied by a new water supply and sewage disposal system installed under the 1998 utility improvement construction contract (Package D164).

Recommended Treatments. Because of the age of the piping, and the fact that much of the historic piping has already been removed from the building, it is recommended that all of the existing piping in the building be removed and replaced with new piping. The configuration of the new piping will depend on new fixture layouts proposed for the restrooms. In the case of the domestic water piping, all of it should be replaced with copper pipe and fittings. The soil, waste, and vent piping should be replaced with cast iron no-hub pipe and fittings. Domestic water will be supplied by the new water supply system and sewage will be directed into the new sewage disposal system.

Depending on the amount of domestic water use, the water heater(s) may be electric or gas. If the domestic water use is limited to lavatories in the private and public restrooms, it is recommended that small point-of-use electric tank-type water heaters can be used. If any

showers are going to be installed for park staff use, a gas-fired tank-type water heater should be installed. All new plumbing fixtures and fittings shall be water-conserving (low-flow) type.

Fire Protection Systems

Historic Conditions. Historically the interior of the structure was protected by manual fire extinguishers. There is evidence of this in the historic photographs. Exterior fire protection was provided by two fire trucks (one of which is still extant at the Auditorium building site), and by six fire hydrants near the Auditorium and in adjacent barracks blocks.

Existing Conditions. All of the historic fire extinguishers are gone, but their locations can still be ascertained. At some time in the past, fire hose reels were installed on the walls in the northwest and southeast corners of the gym. These fire hose reels are functional and are currently being fed with water from the domestic water system. One historic, non-functional fire hydrant is located outside the cyclone fence west of the building and a second, functional fire hydrant is located inside the fence east of the building.

As part of the 1998 utility improvement construction contract (Package D164), a complete dry pipe automatic sprinkler system was installed throughout the Auditorium building. This system is fed by a 25 horsepower electric fire pump and 20,000 gallon fire water reservoir located in a new utility building northeast of the Auditorium building. Two new fire hydrants have been installed near the building inside the cyclone fence enclosure that are fed by the same fire pump and reservoir.

Recommended Treatments. Portable fire extinguishers should be provided in strategic locations throughout the building. When the south wing is reconstructed, it should be fully sprinklered. Provision has been made in the new dry pipe sprinkler system to extend that system into the south wing for fire protection.

ELECTRICAL SYSTEMS ANALYSIS

Given the proposed adaptive re-use of the auditorium building in conjunction with the existing upgraded water system and potential additional future loads, it is anticipated that the existing 400 amp service will need to be upgraded to 600 amp service. The existing circuit transformer cabinet (with meter) adjacent to the south wall of the building will need to be relocated when the south wing is reconstructed. It is recommended that a new free-standing circuit transformer cabinet and meter be placed adjacent to the new utility service pole southeast of the building. From that location, overhead power can be brought in to the building as was done historically at or near the historic weatherhead location. As an option, this building service could be underground if necessary working clearances over the roof of the south wing cannot be attained.

All existing electrical wiring within the building should be replaced. Some original lighting fixtures still exist on the exterior, including those at the west entrance and probably those at the upper corner of the east elevation. Most of the auditorium/gymnasium ceiling fixtures are still in place although the majority of the wire guards are missing. To the extent possible, it is recommended that historic lighting fixtures be rehabilitated and reinstalled. For necessary

replacements, it may be possible that similar designs are available. These fixtures would be for general lighting of the historic space. Supplementary lighting, specific exhibit lighting and task lighting should be incorporated into the exhibit, book sales and other modules as much as possible.

The temporary fire and intrusion alarm system that was installed by the county prior to transfer of the building to the National Park Service was not intended to be a complete, permanent installation, but rather to provide a badly needed interim warning system. A complete new fire detection system is recommended, with linkage to the fire suppression system. A new intrusion alarm system with notification capabilities as required for site operations is recommended.

The adaptive re-use will require new telecommunications systems in the building and will require additional dedicated phone lines than are currently in use.

TREATMENT AND USE

TREATMENT AND USE

ULTIMATE TREATMENT AND USE

As defined in the General Management Plan, developed on the basis of the authorizing legislation, the structure will be used as an interpretive center. The building exterior and the assembly room will be the primary focus for the visitor experience. The assembly room will contain the visitor entrance and contact, and most importantly, exhibits relating the story of Manzanar. An audio/visual theatre and a book sales area might also be included or could be located in other building spaces. The assembly room and stage will be restored to the historic period. The spaces in the north wing will be rehabilitated and used for visitor related or administrative functions.

Also proposed in the GMP is reconstruction of the missing south wing of the building. The NPS policy [NPS Management Policies--NPS-2] with regard to reconstructions is that "A vanished structure may be reconstructed if (1) reconstruction is essential to public understanding of the cultural associations of a park established for that purpose, (2) sufficient data exist to permit reconstruction on the original site with minimal conjecture, and (3) significant archeological resources will be preserved in situ or their research values will be realized through data recovery."

Along with historic photographs and other documentation, this south wing can be reconstructed so that its exterior appearance will be historically accurate. Some documentation exists that indicates that the south wing interior was almost a mirror image of the north wing; however, the interior would be adaptively used so interior restoration is not necessary. The missing wing exists as part of the VFW and American Legion Post in Lone Pine. Although modified, it is believed that enough original integrity remains to provide corroboration of original construction. The roof eave is identical to that of the north wing of the auditorium and the siding appears to be the same as the original of the auditorium building. A paint examination could be done for confirmation. Near the VFW/American Legion Posts is an original, but stuccoed, Manzanar barracks building.

REQUIREMENTS FOR TREATMENT

Legal and regulatory requirements include meeting the provisions of the USDI Rehabilitation Standards and Guidelines for Rehabilitating Historic Buildings, NPS Cultural Resources Management Guideline (NPS-28), as well as building code, life safety, accessibility, fire protection, energy conservation and hazardous materials standards and regulations.

Life Safety

Requirements are governed by the Uniform Building Code (UBC) and the Life Safety Code (NFPA 101). The occupancy category is assembly, Type A-2.1 (UBC, Table 3-A). The construction type is frame (Type V - Table 5-B). This assembly occupancy is not permitted in a frame building unless it has one hour fire protection characteristics which can be achieved with a fully automatic fire suppression system. (This exception having been used, the suppression

system cannot be used again to offset other requirements). An automatic fire suppression system has been installed.

The greatest requirements for emergency egress are of course the public spaces. The auditorium/gym contains 7,680 square feet of floor space. At 15 square feet per person, the basic occupancy load is 512 persons. This will be increased for space used in either the north or south wing for the audio-visual presentation or book sales. For an audio-visual presentation space, the occupancy load is calculated using 7 square feet per person. In either case the total calculation of the required exit door width using say 1,000 square feet of the north wing would be $512 + 1,000/7$ equals 655 persons. The required exit door width is 131 inches $(655)(0.2)$ or approximately 11 feet. Assuming three double doorways at the west entry and restoration of one double doorway exit from each of the northeast and southeast corners of the building, this requirement is more than met with the total of the five historic openings being approximately 25 feet. The maximum travel distance to any exit may not be greater than 250 feet (UBC 1004.2.5.2.2).

If the audio-visual space is in the north wing the required exit door width for 1,000 square feet of space used would be 28.6 inches from that space, with two exit paths required. This indicates that each doorway from that space may be single leaf (i.e., double doorways are not required).

Any other necessary exit path into the exit paths from the auditorium/gym, such as from the north or south wings or spaces in the stage section, will add to the volumes described above. Even so it would appear that the five primary exit doorways (existing and restored) will meet the requirements (but see accessibility below). There are (and would be) additional separate exits from both the north and south wings for uses in those spaces. The requirements for those spaces will also need to be calculated when those uses are designed in detail.

Accessibility

Although the initial impression is of a flat site, there is a slope from west to east such that the grade at the east end of the building is more than three feet below the auditorium floor level. Even at the west entrance there are two steps, totaling 15 and 1/2 inches, from the sidewalk level to that of the auditorium floor. It will be necessary to construct fully accessible pathways to at least all of the primary entrances and the design must be as unintrusive as possible.

Also the entrance doorways will need to be modified to provide the minimum required accessible width. The historic double doorways are 60 inches in width, each leaf being 30 inches. These doorways (two at the east side of the building and at least one at the west entrance) will need to be widened to a minimum of 34 inches for each leaf (68 inches for the opening). This may be achievable, but most likely not more, at the two east entries because of the limiting width of the hallways (halls 113 and 121). An option may be to provide automatic operators so that both door leaves will open simultaneously. Some doorways within the building will also need to be widened so that all spaces on the main floor will be accessible. The spaces below the stage and those at stage level will not be accessible without the installation of an elevator or lift. If means of access is not feasible or would be unnecessarily expensive, the uses of these spaces will need to be limited.

Accessibility requirements are found in the Uniform Federal Accessibility Standards (UFAS)

Fire Protection

As noted above, an automatic fire sprinkler system has been installed in the building at the time of preparation of this report.⁸⁰ When this construction contract is completed, the building will be fully protected with a permanent fire suppression system. The fire suppression system was designed in accordance with NFPA 13. A temporary fire and intrusion alarm system was installed by the county prior to transfer of the building to the National Park Service. This system was not intended to be a complete, permanent installation, but rather to provide a badly needed interim warning system.

Energy Conservation

Efficiency of the heating and air conditioning systems depends not only on the type of equipment used but also on the building envelop. Reduction of heat gain and heat loss can be achieved relatively easily by insulating the auditorium/gym ceiling, providing double glazing in replacement windows, and insulating the roof and walls of the reconstructed south wing. Where replacement ceilings are required, such as in the north wing and stage areas, these portions can also be insulated. To preserve interior finishes which are in good condition, especially in the auditorium-gymnasium space, it is recommended that these finishes not be removed. For the construction of shear walls or other structural and repair work, it is recommended that the exterior siding and sheathing be removed for access. These sections of walls can then be insulated from the exterior. Portions of some existing exterior walls may thus remain uninsulated but, as discussed in the mechanical systems analysis section, this will not have a significant effect on energy useage. For a vapor retarder at the exterior walls, it is recommended that the interior paint system be specified to contain a vapor blocking component. Also see the mechanical systems analysis section of this report for analysis of alternatives and for standards

Hazardous Materials

The primary concern for construction and maintenance activities will be lead-containing paint. Much historic material can be preserved, especially within the building interior, and can be refinished with new paint to provide encapsulation. All construction and maintenance activities must be conducted in accordance with federal and state regulations for the handling of materials having lead containing finishes or for the disposal of materials having lead containing finishes.

⁸⁰ Construction contract 1443-CX-8360-97-004, issued September 1997. As of the end of June 1998, the sprinkler system installation was complete except for punch list items. The utility building to the northeast of the auditorium had been constructed but the water supply well had not been drilled and the emergency generator was not installed, so the system was not yet functional.

men's. In the case of the 5 water closets for the public men's room, 2 of those can be urinals (not more than 50%). For the women's room, the number of water closets should be increased above the minimum if possible. A minimum of one additional is suggested. Combining the public and staff restrooms would be more efficient utilization of space but is usually not desirable. Note that these are minimum requirements found in UBC. Other standards may recommend a greater number of fixtures, especially for public uses.

Visitor count information for other sites in the area indicate a higher visitation level than previously estimated. Tour buses will also be expected to significantly contribute to the visitor load. The above discussed minimum requirements tend to be inadequate for fluctuations generated by tour bus groups, special events and periods of high visitation. It is suggested that rest room facilities should be provided at greater than minimum requirements. However, this would severely impact the available space in the building, particularly for staff offices, described below. Other alternatives for public restrooms should be studied. One possibility would be a comfort station adjacent to the visitor parking, say southeast of the auditorium, to handle tour buses and periods of high visitation.⁸¹

First Aid. Provide a small room generally convenient to both the public and staff areas but private for emergency and first aid needs.

Staff Offices. Personnel will include the superintendent, an administrative technician, a clerk-typist, park rangers (one supervisory plus 2 full-time and 4 seasonal), and maintenance staff (one supervisory plus 4 full time and 4 seasonal).⁸² In the park ranger category, the numbers of interpretive and law enforcement personnel are not specified. The total staff proposed is 11 full-time and 8 seasonal. The guideline for office space is found in the NPS Space Management Guideline which states that office space "...should not exceed an average of 125 square feet per person for the primary office area, plus 22 per cent for office support space."⁸³ Office support space means activities that include library or reference space, meeting rooms, file and storage space. The maximum area would thus be 2,897 square feet for a total staff of 19 persons $[(19)(125) + 22\%]$. This amount of space will not be available even with the reconstructed south wing. Using only the 11 full time staff the maximum area would be 1,678 square feet $[(11)(125) + 22\%]$. The available area is estimated to be in the range of 1,300 to 1,700 square feet; therefore there will need to be a maximizing of open and shared space. Ultimately, additional space may be necessary at another location.

⁸¹The present visitation at the Interagency Visitor Center in Lone Pine, California exceeds 250,000 per year and is projected to be double that in the future. This visitor center is a partnership of eight agencies: Inyo County, Mono County, California Fish and Game, California Department of Transportation (CALTRANS), Los Angeles Department of Water and Power (LADWP), U.S. Fish and Wildlife Service, Bureau of Land Management and the National Park Service. Fifteen buses per day are common. On the weekend of September 19 and 20, 1998, the center had 1,400 visitors on each day. U.S. Highway 190 (presently being widened from two to four lanes) currently serves 5-6 million people per year. 85% recreation oriented. Sixty-five per cent of the traffic is from southern California, with a population of approximately 14 million. This population is forecasted to reach 15 million by the year 2010. The annual Manzanar Pilgrimage event has been attended by 3,500 people. (Information provided by Superintendent to Robert L. Carper on September 24, 1998).

⁸²Draft GMP and EIS, December 1995, pg. 32.

⁸³Space Management Guideline, NPS-89, Release No. 1, National Park Service, October 1994.

Other. Janitorial, supplies storage (office and rest room) and mechanical equipment.

TREATMENT ALTERNATIVES CONSIDERED

Reconstruction of South Wing

Functional requirements for building use as outlined in the GMP show the need for the space that would be provided by the south wing. If the south wing was not reconstructed, all of the visitor related activities as well as the interpretive exhibits would need to be accommodated in the auditorium space. This would result in reduced space for exhibits or recreation of part of the historic seating, or both, and public restrooms would be minimal. There would also be insufficient space for the proposed level of staffing, probably requiring additional space elsewhere.

Siding

Preservation versus replacement of the siding was one of the concerns from the outset of NPS management of the site. As part of the recent repainting work some replacement was done in combination with application of a stabilizing primer for weathered wood as a potential means of preserving historic fabric. The effectiveness of this stabilizing primer can be monitored in the interim period before building restoration and adaptive use. In conjunction with this treatment, siding can be replaced over time on an as-required basis. However, because of extreme deterioration at the west wall and the structural work that will be necessary on all of the building, most of the siding will probably be replaced.

Windows

The conclusion reached after evaluation in this study is that most windows should be replaced. The wood members are extremely weathered causing reduction of wood strength, loss of cross-section and poor paint bonding characteristics. Many of the sash frame members are warped and causing loss of weather protection and glazing failures.

Doors

Most historic doors are missing or in poor condition. The historic doors were not durable and provided poor security because of their lightweight construction. For replacement doors, and for repair where possible, design and construction provisions for better durability, security and accessibility should be incorporated.

Reconstruction of Stage: The modifications made in the 1950s are not significant to the building history and the original stage configuration should be reconstructed to properly interpret the site history.

Auditorium/Gymnasium Floor

Alternatives for reconstructing this floor to its historic appearance are (1) to remove the existing concrete slab and earth fill (ca. 1954) and reconstruct the floor system similar to the original, but with increased load carrying capacity or (2) to retain the existing concrete slab and construct a reproduction wood floor using the slab for support. The second alternative is recommended, with advantages discussed below.

Auditorium/Gymnasium Ceiling

Replacement with a material similar to the original would not provide needed improvement of fire resistance of the building or provide rigidity for support of ceiling insulation. Gypsum board is recommended even though the additional weight will require strengthening of the ceiling framing system but other factors also contribute to the need for this strengthening.

Insulation of Walls

Because of the good condition of the interior wall boarding in the auditorium-gymnasium space, it is important to disturb this material as little as possible. As described in the mechanical systems analysis, the effect of insulation versus no insulation in some of the walls is not as significant as ceiling insulation or insulating window glazing. However, it will be necessary to remove siding and sheathing on many large wall sections for structural or other work which will permit installation of insulation from the exterior. This can be unfaced batt insulation. It is suggested that a vapor-retardant paint system be used on the interior wall boarding along with some means of sealing the joints of this interior board finish. For the in-fill of the east stage wall and for the south wing reconstruction, batt insulation and a standard vapor retarder film can be installed.

Type of HVAC Equipment and Locations

Locating cooling equipment in the attic was considered to minimize visible elements on the building exterior and to minimize ducting. However, this alternative was rejected because it would require large ceiling grilles for air supply as well as more structural reinforcing. Ceiling grilles would probably be more visually intrusive than wall grilles because the large expanse of ceiling draws attention to it. Heating for the auditorium space is proposed to be a radiant grid in the floor. Mechanical equipment for the north and south wings as well as the auditorium space is proposed to be located in the lower level spaces below the stage. The mechanical systems analysis of this report describes advantages and disadvantages of other alternative heating and air-conditioning systems.

RECOMMENDED TREATMENTS

Roofing

The timing for replacement of the roofing will be influenced by the design selected for providing the needed resistance in the roof system for earthquake loading. The preferred method would be to install truss bracing in the attic in conjunction with a full auditorium ceiling diaphragm. This approach would permit retention of the existing roofing for as long as the system remains sound. When replacement is necessary, new roofing should be a black mineral surfaced roll roofing similar to the original. It is also important to maintain flashings to prevent entry of water into the walls.

Gutters and Downspouts

Although the building did not originally have gutters and downspouts, preservation of siding and windows would be enhanced by retention of the existing gutters and downspouts, with repairs and improvement, then future replacement when needed. The most important locations are the main roof eaves to reduce splashback from the wing roofs on windows and siding.

Exterior Siding

The majority of the west elevation siding, and large sections of siding on other elevations, will require replacement in-kind following structural work. Repainting should be done in the correct historic color following a paint analysis.

Main (West) Entrance Restoration

Very little needs to be done to restore the historic appearance of the west entrance, as this portion of the building has not been significantly modified:

- Remove in-fill at west wall to expose historic columns (see historic photos).
- Install reproduction wood panel doors at the three original entrance openings. The replacements should be constructed and detailed in such a manner that would improve security and longevity without compromising historic appearance. (Also see doors below.)

Stage Restoration

The construction of the original stage and the restoration of the exterior east elevation of the building to its original appearance is proposed in the GMP. Based on historic photo documentation and physical evidence, the stage and associated stair access can be restored with minimal conjecture.

- Remove existing in-fill wall framing and sheathing at the east auditorium\gym wall and at north and south wall of the existing vehicle entry 118.
- Remove concrete ramp down to historic concrete level in the center section of the original stage space (the present ramp, space No. 118). Preserve the historic concrete slab if possible.
- In-fill and blend new exterior wall with existing east wall to restore historic stage back wall.
- Restore and reestablish historic stage opening.
- Restore and reestablish historic stage floor.
- Reestablish historic stair access on both north and south sides of stage.

Auditorium/Gym Floor Restoration

The existing (ca. 1954) concrete slab is in good condition. Rather than removal of the slab and the earth fill to reconstruct the wood floor framing in its original configuration, there would be advantages in retaining the concrete. A radiant heating grid could be installed along with a new flooring system on sleepers which would have the same appearance as the original but would have greater strength as well as offering a good radiant heating system. Although most of the perimeter of the existing slab will need to be removed and replaced for structural work, the overall cost may be less than demolition of all of the existing slab and reconstruction of the former type framing system. This would also still provide space for electrical conduit for exhibit power and lighting.

The most prudent approach to restoration of the auditorium/gym floor would be to leave the concrete slab in place and construct the new wood floor framing on treated wood sleepers. Not only are there economic advantages to this approach, but the concrete would act as an effective termite barrier in this area, though other perimeter locations would still require measures to protect the structure from termites. To prevent termite access to the flooring system, termite shields will be necessary at the perimeter of the floor and all joints in the concrete slab.

South Wing

Review of the functional requirements for operation of the facility indicates that reconstruction of the south wing will be needed to provide adequate space for necessary staff and public functions. As shown in the accompanying concept drawings, public restrooms and staff operations or visitor related functions would be the most appropriate uses for the reconstructed adaptively used space. The exterior would be reconstructed in its historic detail but the interior would be organized and constructed for present day functions. Except for the relationships to exterior door and window openings, there is no need to reconstruct the historic interior wall configurations. It is proposed that the public restrooms be in the section that historically was the health unit, which extended beyond the east end of the main building, to minimize disturbance in the interpretive areas while providing the greatest convenience to the visitor parking and bus drop-off areas. There is adequate information from historic photos.

documentary data, the existing north wing and the remaining fabric of the south wing in Lone Pine for comparison to restore the exterior historic appearance of the south wing.

Window Restoration

Most of the exterior surfaces of the the wood sash members are too deteriorated to retain paint and in addition many are too warped to be usable. By salvaging usable sash members and glass, it may be possible to reassemble some units from original material. (All repair work and disposal of materials must be managed in accordance with federal, state and local regulations pertaining to lead paint). The recommended primary approach is replacement along with possible design modifications to provide other protection and energy saving benefits. Additionally the sash will require flashing and weather-sealing detailed in such a manner so as not to affect the historic appearance. There also appears to be historic hardware that could be rehabilitated and reinstalled in new or rehabilitated operable sash. The following factors should be considered in determination of the final treatment approach:

- New glazing of tempered or an impact resistant material (polycarbonate glazing) will provide protection of the building interior and its contents from vandalism.
- New UV blocking glass will provided protection of exhibit items and furnishings from ultraviolet degradation.
- New insulating glazing will reduce heat gain and consequently provide energy savings. An alternative would be separate interior mounted glazing panels. However, the thickness of the sash members is adequate for insulating glazing units without adversely affecting the historic appearance of the windows and this would therefore be the preferred approach. Analysis of the relative benefit of insulating glazing in terms of cooling load energy use reduction is found in the mechanical systems analysis section of this report.

Salvage all wood sash and determine which units have enough integrity to warrant preservation.

Salvage all operable hardware and rehabilitate as required.

Install new or rehabilitated window sash so that they can be removed. New units, fixed or operable, will require flashing and weatherstripping.

Door Restoration

Replacement doors that match their historic counterparts in appearance will have to be detailed in such a manner that they can withstand the rigors of daily use and also be resistant to break-ins. Some doorways will require widening, also with new doors, for accessibility. Most hardware will need to be replaced to meet accessibility standards. Repair and refinishing of historic doors will need to be accomplished in accordance with lead paint regulations.

- Salvage all historic doors and panic hardware.

- Install new doors and frames where required. New exterior units, fixed or operable, will require flashing and weatherstripping.
- Install new historically-compatible lock-sets and panic hardware on all doors that require security and are required emergency exits. Provide accessible hardware as required.

Ceilings

For replacement ceilings, especially in the auditorium/gym, the new material/system will need to provide an appearance in texture, configuration and color similar to the historic as well as improve the fire resistance of the building. A more rigid material is also needed to prevent sagging ("oil-canning") of the ceiling finish, especially with the addition of insulation. Gypsum board will meet these requirements, although it may be possible to use other lighter-weight materials to achieve these requirements. (A fire-rated separation is not required between the auditorium and attic spaces.) Also the acoustical qualities of the material or its surface treatment need to be considered for the assembly room.

Interior Walls

Preserve interior wall boarding to the extent possible. The most important spaces are the auditorium/gymnasium and the west entrance, which are fortunately in relatively good condition. To avoid loss of historic interior fabric, the portions of these walls exposed to the exterior but not requiring exterior siding removal for structural or other work can be left uninsulated.

Much of the stage space will need to receive replacement boarding, probably including extant original material that has a build-up of bird droppings. Before final action a test cleaning panel is recommended followed by lab tests to determine if detrimental chemicals remain in the paint or wood.

When the vehicle entrance through the former stage space was constructed in the 1950s, the stage side of the remaining and new walls were covered with flooring from the auditorium floor. When this material is removed for restoration of the stage, samples need to be salvaged for the building artifact collection.

In the spaces of the north wing and adjacent to the stage, remove post-historic period wall materials, replace deteriorated or damaged material, but otherwise retain as much sound original material as possible.

Finishes

Repaint the interior in its original color scheme. As described above the primary scheme in the auditorium/gymnasium was a dark brown color on the first 10 board courses (to approximately 50-inches above the floor), medium beige the next 10 courses (to 100-inches), and light beige

TREATMENT AND USES

the rest of the way up to the ceiling line. It appears that these colors were used in other parts of the building as well. A paint analysis will be needed to determine the exact color hues. Wood floors will need a durable clear finish.

Compatible Exhibit Entrance and Floor Modifications

A customarily designed garage type door should replace the existing rolling door at the exterior southwest corner of the auditorium/gym. The new floor in this area will need to be strengthened to accommodate the weight of the historic fire truck. If in the future an alternative means of protecting and exhibiting the fire truck is provided, such as reconstruction of the fire truck in Block 13, the door could be removed and the wall restored to its original appearance. Alternatively, these provisions would not be required if it is determined to protect and exhibit the fire truck at another location prior to adaptive use of this building.

The space toward the west end of the north wing which now has a concrete floor has double door access both to the auditorium/gymnasium space and the exterior. These are historic double door openings. It is recommended that this space be used for shipping and receiving and a work space. This will provide a work space for setting up, changing and maintenance of exhibits. The double doors should be adequate for moving exhibit components in and out of the exhibit areas.

Exhibit Systems

Because the auditorium/gymnasium space is the primary significant interior space (and perhaps more significant than the exterior of the building) it is recommended that exhibit systems be designed as units independent of the building, and not more than 8 feet in height when open or 10 feet when enclosure is needed. Enclosed or partially enclosed modules can be customarily designed for incorporation of interactive interpretive components, such as oral histories, videos and computer-driven programs. Electrical service can be provided by a floor outlet grid for each module for lighting, special exhibit case climate control, audio-visual and other equipment.

Hazardous Materials

Prepare a management plan for lead containing finishes.

Pest Management

Prepare an integrated pest management plan for the site. Determine what additional inspections and testing are necessary. Critical treatment needs are for termites and removal of bee nests in building walls.

Visitor Circulation and Site Restoration

As proposed in the General Management Plan, it is appropriate to provide visitor parking east of the building (nearest the entrance to the historic site from U. S. Highway 395) because of the interpretation of the historic context of the camp to the west of the building. This however presents the difficult practical problem of enticing visitors to walk around the building from the parking to the historic main entrance on the west side. And this will be particularly undesirable for people needing an easily accessible entrance. The main west entrance and the two east entrances, even though the later were historically secondary, will be equally important for emergency egress, accessibility and visitor convenience. Therefore, it is proposed that site design incorporate the concept of shaping the ground with earth fill to provide ramping with hard walking surfaces toward the entrances with a minimum need for handrails to minimize the visual modifications to the site. Ground surface drainage must still be accommodated as well.

Because the site was historically dirt without any plantings except at the west entrance, walkways to and around the building should be surfaced with a material that will be of the same color as the surrounding dirt grounds. However, the concrete entrance walks and planting beds at the west entrance are recommended to be restored and replanted, and a replacement flagpole installed.

Structural

Provide additional earthquake resistance analysis for a performance based design to determine the feasibility of providing an acceptable degree of building protection beyond life-safety requirements but within an acceptable level of fabric intervention. See the "Structural Analysis and Findings" section earlier in this report and the seismic evaluation, Appendix J, for more complete descriptions of the recommended treatments for the structural systems.

Roofs and Auditorium Ceiling. Modify roof trusses to relieve overstressed members and joint connections.

Provide roof bracing or diaphragms to resist lateral (earthquake) loading. For the auditorium-gymnasium roof, the preferred method would be a truss bracing system rather than a roof surface diaphragm. This would avoid the difficulty of preparing or removing the asphalt coating on the historic sheathing to receive a plywood diaphragm. See the seismic evaluation (Appendix J) for additional information.

Increase load-carrying capacity of auditorium-gymnasium ceiling framing by sistering new joists along existing joists.

Provide diaphragm bracing in the plane of the auditorium-gymnasium ceiling. It is proposed that this be integrated with the preferred roof bracing approach as described in the seismic evaluation.

Walls. Remove deteriorated wood at bases of truss columns and replace with new wood or with concrete pedestals. Anchor the truss columns to their footings.

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Eliminate soil to wood contact along the interior face of the auditorium walls and walls of the north wing below the concrete floor slabs and along the exterior face of building walls.

Provide shear wall capacity to provide resistance to lateral (earthquake) loading. Sections of walls need to be designed as either diaphragm shear walls or with braced frames. New concrete grade beams or enlarged footings at the base of these walls may be needed.

Provide bracing for the cripple walls in the north wing crawl space. The new shear walls or diagonal bracing in the north wing can be designed to also brace the crawl space.

Where the top plates of the walls are discontinuous at the ends of the auditorium trusses, install light gauge steel straps across the discontinuities. Connect the roof system bracing or diaphragm to the diaphragm chords and struts.

Floors. Investigate the north wing floor framing for rot or insect damage and install new framing members as needed to improve its load-carrying capacity.

Install light gauge beam-to-post and post-to-foundation connectors in the north wing crawl space.

Foundations. Install new concrete grade beams or enlarged footings at the base of new shear walls or new braced frames.

Provide means of interconnecting footings of the north wing, if required by further analysis, by either bolting continuous steel members to the footings or installing a slab-on-grade around, and doweled into, the footings.

Mechanical Systems

Building Envelope. The walls, floors, and roofs of the building should be insulated as much as is practical without removal or destruction of the interior finishes in the auditorium-gymnasium section. Insulated window glazing units are also recommended.

Heating, Ventilating, and Air Conditioning System. The systems recommended for implementation are:

- Single-stage evaporative coolers and hydronic (hot water) radiant floor heating system for the gym and stage areas, with a propane-fired makeup air unit for ventilation in the heating season.
- Air cooled package air conditioners with hot water heating coils for the remaining spaces in the building to be conditioned.
- High efficiency propane-fired hot water boilers to provide hot water for the radiant floor heating system and the hot water coils associated with the package air conditioners.
- Toilet exhaust systems in all of the new restroom spaces.

Plumbing Systems. It is recommended that all of the piping in the building be replaced with new piping. New domestic water heaters should be provided as necessary. All new plumbing fixtures and fittings shall be water-conserving (low-flow) type.

Fire Protection Systems. When the south wing is reconstructed, it should be fully sprinklered, with its sprinkler system connected to the existing (1998) dry pipe sprinkler system in the Auditorium building. It is recommended that portable fire extinguishers be installed in strategic locations throughout the building.

Electrical Systems

Upgrade site power supply as required. Relocate the circuit transformer cabinet and meter to the new utility pole location and provide an overhead drop to the building at the historic location.

Replace all wiring systems within the building.

Restore historic exterior and auditorium-gymnasium space lighting fixtures or replace as required with similar fixtures for general lighting.

Provide separate supplementary lighting, specific exhibit lighting and task lighting incorporated into exhibit, book sales and other functional modules as much as possible.

Provide a new fire detection system, a new intrusion detection system and new telecommunications systems.

Evaluation of Effects

Reconstruction of South Wing. An accurate reconstruction of the exterior can be accomplished from historic documentation. The space is required for operation and interpretation of the historic site.

Reconstruction of Stage and Auditorium/Gym Floor Restoration. Accurate reconstruction can be accomplished from historic documentation and physical evidence. This will restore the most important interior space to its period of significance.

Siding Replacement. Much of the siding is badly deteriorated and warped. All of the original siding is contaminated with lead containing paint. Siding replacement will probably be necessary on wall sections where structural improvements are required. Replacement of siding on other wall areas on an as-required basis will also be a loss of historic fabric but this needs to be considered as a cyclic renewal of the exterior cladding of the building. Good maintenance will reduce the frequency of needed replacement in the future.

Windows. Loss of historic fabric will occur by replacement of most windows but this cannot be avoided because of extreme deterioration of the originals.

TREATMENT AND USES

Doors. Loss of historic fabric will occur by replacement of most still extant exterior doors required because of deterioration, damage and requirements for durability, security and accessibility.

Replacement of Ceiling Materials. Loss of historic fabric will occur by replacement of most ceiling materials required because of deterioration and the need to improve the fire resistance of the building. The replacement material can be finished to have an appearance similar to the historic ceilings.

PROJECT PHASING

Site water supply and fire suppression has been undertaken as a first phase, and is nearly complete.

To the extent that construction funding may need to be done in small increments, at least initially, high priority work recommended includes:

1. Structural work, especially repair of rotted column bases and seismic strengthening, and exterior weatherization.
2. Completion of exterior repairs and restoration.
3. Basic electrical system upgrading and installation of permanent fire and intrusion detection system.
4. Windows and exterior doors.

ESTIMATED CONSTRUCTION COST

Rehabilitation of the building as described and recommended in this report is:

Structural and exterior rehabilitation	\$ 657,500
Interior rehabilitation, including stage reconstruction	522,300
South wing reconstruction	279,300
Mechanical systems	417,400
Electrical systems	<u>182,400</u>
Total, net construction, 1998 dollars	\$ 2,058,900
Inflation to 2001 (4% per year)	<u>257,100</u>
	\$ 2,316,000

This includes restoration of historic site features at the west entrance and site work for accessible entrances. The sub-categories above are not intended to be compared to any previous estimates because the items included in each sub-category will not be the same. The above does not include furnishings, exhibits, visitor parking or other structures.

RECOMMENDED ADDITIONAL DOCUMENTATION AND STUDIES

1. Paint analysis to determine historic period exterior and interior colors.
2. HABS documentation of VFW/American Legion Post in Lone Pine, which consists of the extant portions of the original south wing of the Auditorium.
3. Future documentation of the record of treatment.

DRAWINGS

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HISTORY

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National Archives, Washington, D.C.

Record Group No. 210, Records of the War Relocation Authority

Entry No. 48, Records of Relocation Centers, 1942-1946
Subject-Classified General Files

Box No. 70, Manzanar Relocation Center
Relocation Center Records
Manzanar Final Reports
File: Vol. 5, Engineering Section

Box No. 71, Manzanar Relocation Center
Relocation Center Records
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Box No. 220, Manzanar Relocation Center
Central Files
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Box No. 224, Manzanar Relocation Center
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File No. 41.079A - Project Director's Bulletins

BIBLIOGRAPHY

National Archives, San Bruno, California (Sierra-Pacific Division)

Record Group No. 49. Records of the Bureau of Land Management (successor to the General Land Office)

Series No. 95

Box No. 919

File No. 81277 - Explanatory Notes - Appraisal of Buildings and Structures — Manzanar Relocation Center

Inventory and Appraisal of Equipment and Furnishings of Auditorium

National Archives, Laguna Niguel, California (Pacific Southwest Region)

Record Group No. 210. Records of the War Relocation Authority

File No. 1

File No. 2

University of California at Los Angeles, University Research Library, Special Collections

Collection No. 122. Manzanar Collection (Principally if not exclusively the records of Project Director Ralph Merritt's Administrative Office at Manzanar)

Box No. 47. Folder I. Ralph Merritt's office diary, presumably kept for him by his secretary

Manzanar National Historic Site, Park Headquarters, Manzanar, California

Research files compiled by NPS Historian Harlan Unrau in writing historic resources study on Manzanar: 8 boxes.

Eastern California Museum Archives, Independence, California

Correspondence and Bill of Sale of Auditorium, War Assets Authority to County of Inyo

Correspondence and Lease of land on which Auditorium stands and surrounding grounds, Los Angeles Department of Water and Power to County of Inyo

NEWSPAPERS

Manzanar Free Press. A complete run of this newspaper in Collection No. 122, Manzanar Collection, in the Special Collections Library of the University Research Library at the University of California at Los Angeles is the set used in research for this report. It is believed the National Archives also has a complete run of the paper, and several other repositories may have partial or complete runs.

BUILDING REFERENCE DATA

National Register Nomination, July 30, 1976 (date of entry in the National Register); National Historic Landmark data, February 4, 1985 (also date of entry); and National Park Service List of Classified Structures data files.

Historic American Buildings Survey drawings and report, 1994 HABS Drawing No. CA-2399, 2 sheets; historic camp layout maps: HABS Drawing No. CA-2399A, Auditorium, 9 sheets. See Appendix C. Other drawings are: HABS Drawing No. CA-2399B, 2 sheets, Military Police Post; HABS Drawing No. CA-2399C, 1 sheet, Internal Police Post; HABS Drawing No. CA-2399D, 2 sheets, Cemetery; HABS Drawing No. CA-2399E, 2 sheets, Reservoir; and HABS Drawing No. CA-2399F, 1 sheet, Observation (Guard) Tower. These drawings are also filed at the Denver Service Center with drawing numbers 359, 25000 through 25006.

Pest management investigations and recommendations, letters from Pestmaster Services, Bishop, CA, August 23, 1995 and October 9, 1995.

Window evaluation and recommendations, draft report, Gordon White, Historical Architect, GOGA/PRES 1996. See Appendix E.

Asbestos testing and abatement: *Project Close Out Report, Death Valley (Scotty's Castle) and Manzanar*, CAL Inc., Vacaville, CA, November 22, 1996.

Lead-based paint: *Lead-Based Paint Survey*, Cal Inc., Vacaville, CA, contract order No. 1443PX8000-97-117, April 14, 1997.

FEMA 178/June 1992 *Seismic Evaluation, Manzanar Auditorium Building, ... Final Report*, Martin/Martin, Inc., Wheat Ridge, CO, December 1998.

APPENDIXES

- A Excerpt from "List of Materials for Community Facilities, Manzanar Relocation Center," prepared by the Farm Security Administration, August 5, 1942.
- B "Engineering Section," by Arthur M. Sandridge and Oliver E. Sisler, Manzanar Relocation Authority, February 1946, part of the War Relocation Authority, *Final Report, Manzanar War Relocation Center*. Chapter 2, WRA Construction, Part I, New Construction, B, Gymnasium-Auditorium." Document on file in National Archives.
- C HABS drawings and report (HABS No. CA-2399A)
- D Conceptual sketches of site and building use prepared for site utilities planning, DSC, October 1996.
- E Door and window analysis and repair recommendations, prepared by Gordon White, National Park Service, Presidio Project Office, San Francisco, August 1996.
- F Details of furnace flue enclosures and vent details in Projection Room and furnace rooms originally constructed in part with asbestos materials, recorded by George Voyta, August 1996, before asbestos abatement work.
- G Existing Finishes Schedule.
- H Mechanical Systems Data
- I Structural Calculations.
- J "FEMA 178/June 1992 Seismic Evaluation, Manzanar Auditorium Building..." Final Report, Martin/Martin, Inc., Wheat Ridge, Colorado, December 1998.

APPENDIX A: LIST OF STRUCTURAL MATERIALS

Excerpt from "List of Materials for Community Facilities, Manzanar Relocation Center."
prepared by the Farm Security Administration, August 5, 1942.

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Structural Materials
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GYMNASIUM

Center 1942: High School

NUMBER OF PIECES	QTY.	GRADE	NO. RD. FT. OR QUANTITY	COST
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CONCRETE FOR FOOTINGS AND FLOOR SLABS

Footings (cu. yds. needed)	1:2:4 mix			
	Portland Cement		173 sacks	
	Sand		14 cu. yds.	
	Gravel 1" and under		29 cu. yds.	
Floors (cu. yds. needed)	1:3:3 mix			
	Portland Cement		85 sacks	
	Sand		11 cu. yds.	

LUMBER FOR SUB-FLOOR CONSTRUCTION

Sleepers, End Stage	34	6" x 10" 16'-0"	Cresoted No. I.D.F.	6720
Sleepers, Wings	32	4" x 10" 18'-0"	Cresoted No. I.D.F.	1901
Sleepers, Porch	8	4" x 6" 12'-0"	Cresoted No. I.D.F.	202
Outside Steps	15	2" x 4" 14'-0"	No. I.D.F.	148
Stage Sleepers	72	2" x 4" 16'-0"	No. I.D.F.	781
Cists	223	2" x 6" 20'-0"	No. I.D.F.	4460
Cists	227	2" x 6" 18'-0"	No. I.D.F.	4086
Cists	65	2" x 8" 8'-0"	No. I.D.F.	676
Cists	85	2" x 8" 16'-0"	No. I.D.F.	1768
Cists				
Blocking	101	2" x 6" 16'-0"	No. I.D.F.	1621
Cists				
Bridging	10	2" x 3" 16'-0"	No. I.D.F.	80
Flooring (sub)	18,768	1" x 4"	No. 2 D.F.	18,768
sq. ft.				
Flooring	12,083	1" x 4" T & G	"C" V.G.D.F.	12,083
Finish	sq. ft.			
Under				
Stage	40	2" x 6" 12'-0"	D.F. No. 2	225
Sleepers				
Footings	50	3" x 1 1/2" x 14"		
Between finish & sub-floor	12 squares	6 lb. Bldg. Paper		
At Sleeper				
End	40	1" x 2" x 16'-0"	D.F. #2	100

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Structural Materials
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GYMNASIUM

Junior - Senior High School

ITEM	NUMBER OF PIECES	SIZE	GRADE	NO. BD. FT. OR QUANTITY	COST
<u>LUMBER FOR ALL FRAMING & INTERIOR FINISH</u>					
<u>RIGHT & LEFT</u>	48	2" x 4"	8'-0"	No. 1 D.F.	264
<u>TING</u>	306	2" x 4"	8'-0"	No. 2 D.F.	1683
Wall Framing	80	2" x 4"	10'-0"	No. 1 D.F.	560
	44	2" x 4"	10'-0"	No. 2 D.F.	306
	66	2" x 4"	12'-0"	No. 1 D.F.	528
	28	2" x 4"	14'-0"	No. 1 D.F.	252
	14	2" x 4"	14'-0"	No. 2 D.F.	126
	10	3" x 4"	8'-0"	No. 1 D.F.	80
	20	3" x 4"	14'-0"	No. 1 D.F.	280
	22	2" x 3"	10'-0"	No. 1 D.F.	110
	4	2" x 2"	8'-0"	No. 1 D.F.	12
Plywood	27	4'-0" x 8'-0" x 5/16"	W.F.		864 sq.ft.
Sheathing		1" x 6"	No. 2 D.F.		2350
Siding, Flush		1" x 5" Shiplap	"C" D.F.		1900
<u>AUDITORIUM</u>	14	2" x 4"	10'-0"	No. 1 D.F.	96
Wall Framing	7	2" x 4"	10'-0"	No. 2 D.F.	49
	8	2" x 4"	12'-0"	No. 1 D.F.	64
	131	2" x 4"	12'-0"	No. 2 D.F.	1048
	72	2" x 4"	16'-0"	No. 1 D.F.	792
	16	2" x 4"	16'-0"	No. 2 D.F.	176
	4	2" x 4"	18'-0"	No. 1 D.F.	48
	166	2" x 4"	18'-0"	No. 2 D.F.	1992
	8	2" x 10"	10'-0"	No. 1 D.F.	126
	16	2" x 10"	12'-0"	No. 1 D.F.	320
	88	2" x 10"	16'-0"	No. 1 D.F.	2376
	6	2" x 10"	20'-0"	No. 1 D.F.	198
	8	2" x 6"	8'-0"	No. 1 D.F.	64
	4	2" x 6"	18'-0"	No. 1 D.F.	72
	3	2" x 4"	10'-0"	No. 1 D.F.	21
	1	4" x 4"	12'-0"	No. 1 D.F.	16
	1	4" x 4"	8'-0"	No. 1 D.F.	8
	24	3" x 6"	12'-0"	No. 1 D.F.	432
ceathing		1" x 6" random			
		length	No. 2 D.F.		6100
dins (Interior)		1" x 6" flush			
		shiplap	"C" D.F.		2200
ndow Guards		1 1/4" x 6"	"C" D.F.		2700 l.f.
nsul Insulation		2" thick			330 sq.ft.

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GYMNASIUM

Junior-Senior High School

	NUMBER OF PIECES	SIZE	GRADE	NO. BD. FT. OF QUANTITY	COST
<u>GYMNASIUM ROOM</u>					
Plating	13	2" x 4" x 10'-0"	No. 1 D.F.	91	
	23	2" x 4" x 12'-0"	No. 1 D.F.	164	
	88	2" x 4" x 18'-0"	No. 2 D.F.	1056	
	1	2" x 6" x 10'-0"	No. 2 D.F.	10	
	14	2" x 6" x 12'-0"	No. 1 D.F.	168	
	11	2" x 6" x 12'-0"	No. 2 D.F.	132	
	41	2" x 6" x 16'-0"	No. 2 D.F.	656	
	4	3" x 6" x 10'-0"	No. 1 D.F.	60	
	2	4" x 6" x 12'-0"	No. 2 D.F.	48	
	2	2" x 8" x 12'-0"	No. 1 D.F.	32	
	30	2" x 8" x 14'-0"	No. 1 D.F.	772	
	2	2" x 8" x 12'-0"	No. 1 D.F.	12	
	1	2" x 2" x 10'-0"	No. 1 D.F.	4	
Plating (Interior)		1" x 6" Flush			
		Shiplap	"C" D.F.	1100	
Plating		1" x 4" T & G	"C" V.G.D.F.	480	
Plating (Wall)		1" Gypsum bd.		4000 sq.ft.	
<u>SECTION ROOM</u>					
Wall Framing	3	2" x 4" x 8'-0"	No. 1 D.F.	18	
	61	2" x 4" x 8'-0"	No. 2 D.F.	366	
	24	2" x 4" x 10'-0"	No. 1 D.F.	168	
	16	2" x 4" x 12'-0"	No. 1 D.F.	128	
	4	2" x 4" x 12'-0"	No. 2 D.F.	32	
	1	2" x 4" x 14'-0"	No. 1 D.F.	9	
	4	2" x 4" x 14'-0"	No. 2 D.F.	36	
	2	2" x 6" x 10'-0"	No. 1 D.F.	20	
	1	2" x 6" x 12'-0"	No. 1 D.F.	12	
	3	3" x 4" x 14'-0"	No. 1 D.F.	42	
	3	2" x 3" x 10'-0"	No. 1 D.F.	15	
	1	2" x 2" x 12'-0"	No. 1 D.F.	4	
	2	4" x 6" x 9'-0"	No. 1 D.F.	32	
	1	6" x 8" x 8'-0"	No. 1 D.F.	32	
	1	6" x 8" x 18'-0"	No. 1 D.F.	72	
Plating Finish		1" Gypsum board		985 sq.ft.	

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GYMNASIUM

Junior - Senior High School

ITEM	NUMBER OF PIECES	SIZE	GRADE	NO. BD. FT. OR QUANTITY	COST
<u>WALL UNIT</u>					
Wall Framing	23	2" x 4" x 8'-0"	No. 2 D.F.	138	
	11	2" x 4" x 10'-0"	No. 1 D.F.	77	
	30	2" x 4" x 12'-0"	No. 1 D.F.	240	
	5	2" x 4" x 12'-0"	No. 2 D.F.	40	
	7	2" x 3" x 12'-0"	No. 1 D.F.	42	
	3	2" x 2" x 12'-0"	No. 1 D.F.	12	
	4	3" x 4" x 14'-0"	No. 1 D.F.	56	
	6	3" x 4" x 8'-0"	No. 2 D.F.	48	
Sheathing (Interior)		1" x 6" random length	No. 2 D.F.	260	
<u>LUMBER FOR ROOF FRAMING & CEILING FINISH</u>					
Rafters and Blocking	51	2" x 12" x 24'-0"	No. 1 D.F.	2448	
	125	2" x 12" x 22'-0"	No. 1 D.F.	5500	
	5	2" x 12" x 20'-0"	No. 1 D.F.	200	
	2	2" x 12" x 18'-0"	No. 1 D.F.	72	
	56	2" x 12" x 16'-0"	No. 1 D.F.	1692	
	14	2" x 12" x 14'-0"	No. 1 D.F.	392	
	5	2" x 12" x 12'-0"	No. 1 D.F.	120	
	3	2" x 12" x 10'-0"	No. 1 D.F.	60	
	4	2" x 12" x 8'-0"	No. 1 D.F.	64	
	18	2" x 6" x 10'-0"	No. 1 D.F.	180	
	20	2" x 10" x 18'-0"	No. 1 D.F.	600	
	16	2" x 8" x 14'-0"	No. 1 D.F.	304	
	33	2" x 8" x 12'-0"	No. 1 D.F.	628	
	20	2" x 8" x 10'-0"	No. 1 D.F.	260	
Purlins and Blocking	276	2" x 10" x 18'-0"	No. 1 D.F.	8280	
	126	2" x 10" x 12'-0"	No. 1 D.F.	2484	
	5	2" x 10" x 10'-0"	No. 1 D.F.	85	
Eaves Closer	9	2" x 4" x 22'-0"	No. 1 D.F.	135	
	2	2" x 4" x 20'-0"	No. 1 D.F.	27	
	8	2" x 4" x 18'-0"	No. 1 D.F.	96	
	4	2" x 4" x 14'-0"	No. 1 D.F.	38	
	19	2" x 4" x 12'-0"	No. 1 D.F.	152	
Roof Sheathing		1" x 6" random length	No. 2 D.F.	21,000	
Tack Strip	975 l.f.	1" x 2"	No. 1 D.F.	164	
Fascia	525 l.f.	1" x 6"	No. 1 D.F.	265	
Ceiling Mould	3000 l.f.	1" x 3"	No. 1 D.F.	750	
Joint Strip	150 l.f.	2" x 2"	No. 1 D.F.	52	
Ceiling Fin.		$\frac{1}{2}$ " Insulation Board		19,100 sq.ft.	
Ceiling Fin.		$\frac{1}{2}$ " Gypsum Board		660 sq.ft.	

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AVIATION

Concrete and Light Steel

NUMBER OF PIECES	SIZE	GRADE	QUANTITY OR QUANTITY	COST
368 rolls	25 lbs. per roll 3'-0" wide x 36'-0" long black mineral surfaced split sheet			
460 lbs.	Asphalt			
820 lbs.	7/8" large headed roofing nails			
185 lbs.	Cotton mop yarn			
Insulation	2" thick		16,000 sq.ft.	
Staples for Kimsul	5000 staples to a box		5 boxes	
Single Hammer	Sold by Postitch-Western Co., S.F. & L.A.		3 hammers	

EXTERIOR WALL FINISH

Exterior Sheathing	1 x 6 random length	No. 2 D.F.	9800
Exterior Siding	1 x 6 Flush Siding	"C" D.F.	2300
Exterior Siding	1 x 6 "V" Siding	"C" D.F.	7900
Corner Boards 15	1" x 4" x 12'-0"	No. 1 D.F.	60
Corner Boards 20	1" x 3" x 12'-0"	No. 1 D.F.	60
Corner Boards 8	1" x 6" x 10'-0"	No. 1 D.F.	40

MISCELLANEOUS LUMBER & MATERIALS

Lockers 33	1" x 12" x 18'-0"	No. 1 D.F.	600
Lockers 15	1" x 12" x 12'-0"	No. 1 D.F.	180
Lockers 66	1" x 12" x 10'-0"	No. 1 D.F.	660
Lockers 19	1" x 4" x 12'-0"	No. 1 D.F.	76
Shelves 12	1" x 12" x 18'-0"	No. 1 D.F.	216
Shelves 7	1" x 6" x 18'-0"	No. 1 D.F.	63
Shelves 17	1" x 4" x 12'-0"	No. 1 D.F.	68
Shelves 72	1" x 8" x 16'-0"	No. 1 D.F.	764
8	2" x 4" x 12'-0"	No. 1 D.F.	64
4	2" x 8" x 16'-0"	No. 1 D.F.	86
4	2" x 3" x 16'-0"	No. 1 D.F.	32
	1 1/2" x 3/4"	"C" D.F.	1200 l.f.
Corner Flaps 10	4'-0" x 8'-0" x 1/2" S2S Plywood		320 sq.ft.
Mail Stalls 4	4'-0" x 10'-0" x 3/4"	"P. Plywood	160 sq.ft.
Mail Stalls 10	2" x 2" x 14'-0"	D.F. No. 1	47
Mail Stalls 5	1" x 2" x 14'-0"	D.F. No. 1	13

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GYMNASIUM

Junior - Senior High School

ITEM	NUMBER OF PIECES	SIZE	GRADE	NO. BD. FT. OR QUANTITY	COST
Plywood for ducts and registers		$\frac{1}{2}$ " thick	Sound 1 side	600 sq.ft.	
Trim for Plywood Registers	2	1" x 2" x 10'-0"	D.F. #1	4	
Joists for Furred Ceiling	111	2" x 2" x 8'-0"	D.F. #1	296	
Health Unit	8	4'-0" x 5'-0" x $\frac{1}{2}$ "	S2S Plywood	160 sq.ft.	
Health Unit	8	3'-0" x 5'-0" x $\frac{1}{2}$ "	S2S Plywood	120 sq.ft.	
Health Unit	2	2" x 4" x 12'-0"	D.F. #1	16	
Health Unit	8	2" x 2" x 14'-0"	D.F. #1	38	
Health Unit	8	2" x 2" x 18'-0"	D.F. #1	48	
Health Unit	9	4'-0" x 5'-0" x $\frac{1}{2}$ "	S2S Plywood		
Health Unit	2	2" x 4" x 14'-0"	D.F. #1	19	
Health Unit	9	2" x 2" x 8'-0"	D.F. #1	27	
Health Unit	9	2" x 2" x 12'-0"	D.F. #1	36	
Basketball Stops	2	4'-0" x 6'-0" x $\frac{1}{2}$ "	S2S Plywood	48 sq.ft.	
	6	2" x 4" x 12'-0"	D.F. #1	48	
	4	2" x 8" x 18'-0"	D.F. #1	96	
	6	2" x 4" x 18'-0"	D.F. #1	64	
	6	2" x 6" x 14'-0"	D.F. #1	84	
	2	Standard Basket Ball Goal & Net			
	10	12" x 14' Crystal Sheet Mirrors			
Frame for Mirrors	6	1" x 2" x 12'-0"	"C" D.F.	10	
	90 squares	6 lb. bldg. paper			
Clothes Poles	30	$\frac{1}{2}$ " Rd. x 10'-0"		300 l.f.	
Clothes Collars	100	Stock			
Hardwood Grilles		5/16" x 1-5/8" (net)	Oak	700 l.f.	
Hardwood Grilles		1" x 2"	Oak	100 l.f.	
Hardwood Grilles		2" x 3"	Oak	160 l.f.	
Hardwood Grilles		1" x 2"	Oak	60 l.f.	
Creosote	65	gallons		65 gals.	

NAILS

230 lbs.	20d Common Nails
500 lbs.	16d Common Nails
125 lbs.	12d Common Nails
1400 lbs.	8d Common Nails
350 lbs.	8d Casinr Nails
100 lbs.	6d Finishing Nails
30 lbs.	4d Cement Coated Nails
260 lbs.	4d Box Nails
35 lbs.	4d Brads

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GYMNASIUM

Junior - Senior High School

ITEM	NUMBER OF PIECES	SIZE	GRADE	NO. BD. FT. OR QUANTITY	COST
<u>GLASS AND DOORS</u>					
Doors, 2 pan					
Upper Glass	1	2'-8" x 6'-8" x 1-3/8"			
Doors, 2 pan					
Upper Glass	8	2'-6" x 6'-8" x 1-3/4"			
Doors, 2 pan Wood	6	2'-6" x 7'-0" x 1-3/4"			
Doors, 2 pan Wood	2	3'-0" x 6'-8" x 1-3/8"			
	4	2'-0" x 6'-8" x 1-3/8"			
	7	2'-8" x 6'-8" x 1-3/8"			
	28	2'-6" x 6'-8" x 1-3/8"			
Doors, 1 pan Wood	4	2'-0" x 4'-0" x 1-1/8"			
Doors, 2 pan					
Latch	2	2'-8" x 6'-8" x 1-3/8"			
Frames, Exterior	3	1-1/8" x 6-5/8"-5'-0" x 7'-0"		81	
	4	1-1/8" x 6-5/8"-5'-4" x 6'-8"		108	
	2	1-1/8" x 6-5/8"-3'-0" x 6'-8"		48	
	1	1-1/8" x 6-5/8"-2'-8" x 6'-8"		24	
Sill	3	2" x 8" x 16'-0"		63	
Trim	10	1 x 3" x 20'-0"		50	
Stops	10	1/2" x 3-7/8" x 20'-0"		60	
Stops(Int. Doors)	56	1/2" x 1 1/2" x 18'-0"		170	
Glass(Doors)	4	1'-0" x 1'-8"	S.S. "B" Grade		
Glass(Doors)	32	11" x 1'-8"	S.S. "B" Grade		
Door Trim					
(Interior)	56	1" x 2" x 18'-0"		170	
Door Frames					
(Interior)	56	1" x 4" x 18'-0"		340	
Door Trim					
(Interior)	70	3/4" - 3/8" x 16'-0"		1120 l.f.	
Door Trim					
(Exterior)	18	3/4" - 3/8" x 16'-0"		188 l.f.	
Sash 4L	112	4'-0" x 3'-4" x 1-3/4" (A)			
Sash 2L	75	4'-0" x 2'-4" x 1-3/8" (B)			
Sash 2L	12	4'-0" x 2'-4" x 1-3/4" (C)			
Glass (Sash)	448	1'-9-5/8" x 1'-5" S.S. "B" Grade			
Glass (Sash)	116	1'-9-5/8" x 1'-10" S.S. "B" Grade			
	58	1'-9-5/8" x 1'-10" S.S. Obscure			
Putty	675 lbs.				
Glazing Tacks	7 lbs.				

GYMNASIUM

Junior - Senior High School

Material List for (5) - 80 ft. Span Roof Trusses
With Columns: Gymnasium Type "A" (Sheet A-7)

ITEM	NUMBER OF PIECES	SIZE	GRADE	NO. BD. FT. OR QUANTITY	COST
Upper Chord	10	3" x 10" x 18'-0"	Select		
			Strust D.F.	450	
Upper Chord	20	2" x 10" x 18'-0"	Select		
			Strust D.F.	600	
Upper Chord	20	3" x 10" x 28'-0"	Select		
			Strust D.F.	1400	
Lower Chord	20	3" x 10" x 24'-0"	No. 1 Dim D.F.	1200	
Lower Chord	10	3" x 10" x 32'-0"	No. 1 Dim D.F.	800	
Scabs	5	3" x 10" x 12'-0"	No. 1 Dim D.F.	150	
Scabs	10	2" x 10" x 8'-0"	No. 1 Dim D.F.	165	
Web Members	5	3" x 4" x 10'-0"	No. 1 Dim D.F.	50	
Web Members	5	3" x 4" x 18'-0"	No. 1 Dim D.F.	90	
Web Members	10	3" x 4" x 6'-0"	No. 1 Dim D.F.	60	
Web Members	10	2" x 6" x 20'-0"	No. 1 Dim D.F.	200	
Web Members	5	3" x 6" x 14'-0"	No. 1 Dim D.F.	105	
Web Members	20	2" x 4" x 10'-0"	No. 1 Dim D.F.	135	
Web Members	10	3" x 4" x 8'-0"	No. 1 Dim D.F.	80	
Web Members	10	3" x 4" x 10'-0"	No. 1 Dim D.F.	100	
Web Members	5	3" x 4" x 18'-0"	No. 1 Dim D.F.	90	
Web Members	20	2" x 6" x 12'-0"	No. 1 Dim D.F.	240	
Web Members	5	2" x 4" x 18'-0"	No. 1 Dim D.F.	60	
Filler	5	3" x 6" x 8'-0"	No. 1 Dim D.F.	60	
Knee Brace	20	3" x 6" x 18'-0"	No. 1 Dim D.F.	540	
Scabs	5	3" x 16" x 8'-0"	No. 1 Dim D.F.	160	
Column	20	2" x 16" x 22'-0"	No. 1 Dim D.F.	1175	
Column	30	3" x 16" x 22'-0"	No. 1 Dim D.F.	2640	
Total				10,550	

Material List for (1) 50 Ft. Span Stage Truss
With Columns: Gymnasium Type "A" (Sheet A-6)

Upper Chord	4	3" x 6" x 16'-0"	No. 1 Dim D.F.	96
Lower Chord	4	3" x 6" x 16'-0"	No. 1 Dim D.F.	96
Web Members	1	3" x 8" x 12'-0"	No. 1 Dim D.F.	24
Web Members	1	2" x 12" x 16'-0"	No. 1 Dim D.F.	32
Web Members	1	3" x 6" x 12'-0"	No. 1 Dim D.F.	18
Web Members	1	2" x 6" x 16'-0"	No. 1 Dim D.F.	16
Web Members	1	3" x 6" x 12'-0"	No. 1 Dim D.F.	18
Web Members	1	2" x 6" x 16'-0"	No. 1 Dim D.F.	16

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GYMNASIUM

Junior - Senior High School

ITEM	NUMBER OF PIECES	SIZE	GRADE	NO. ED. FT. OR QUANTITY	COST
Web Members	1	3" x 4" x 12'-0"	No. 1 Dim D.F.	12	
Web Members	1	2" x 4" x 16'-0"	No. 1 Dim D.F.	13	
Web Members	1	3" x 4" x 14'-0"	No. 1 Dim D.F.	14	
Seats	1	2" x 6" x 12'-0"	No. 1 Dim D.F.	12	
Filler	1	3" x 6" x 6'-0"	No. 1 Dim D.F.	9	
Column	4	2" x 10" x 22'-0"	No. 1 Dim D.F.	147	
Column	2	3" x 10" x 22'-0"	No. 1 Dim D.F.	100	
Filler	1	3" x 4" x 10'-0"	No. 1 Dim D.F.	10	
Filler	1	3" x 10" x 6'-0"	No. 1 Dim D.F.	15	
Total				648	

Rough Hardware for (6) Trusses With Columns
(5-80'-0" span trusses & 1-30'-0" span truss)
Sheets (A-6 and A-7)

Split Rings	612	4" ϕ	
Split Rings	1144	2 $\frac{1}{2}$ " ϕ	
Shear Plates	276	2-5/8" ϕ	
Machine Bolts	11	3/4" ϕ x 5"	+ 10% on bolts and washers
Machine Bolts	22	3/4" ϕ x 7"	
Machine Bolts	11	3/4" ϕ x 10"	
Machine Bolts	22	3/4" ϕ x 12"	
Machine Bolts	86	3/4" ϕ x 14"	
Machine Bolts	11	3/4" ϕ x 18"	
Machine Bolts	22	3/4" ϕ x 7"	
Machine Bolts	68	3/4" ϕ x 10"	
Machine Bolts	108	3/4" ϕ x 14"	
Machine Bolts	66	3/4" ϕ x 18"	
N.I. Washers	462	3/4" ϕ	
N.I. Washers	550	3/4" ϕ	
Cut Washers	70	3/4" ϕ	
Steel Plates	20	3" x 1/2" x 24"	
Steel Plates	20	2 $\frac{1}{2}$ " x 1" x 15"	
Steel Anchor Plates	10	8" x 5/8" x 4'-6"	
Steel Anchor Plates	2	6" x 1/2" x 4'-6"	
Steel Base Plates	10	11" x 1/2" x 1'-4"	
Steel Base Plates	2	11" x 1/2" x 10"	

GYMNASIUM

Junior - Senior High School

Material List for Truss Bracing - 80 Ft. Span
Truss - Gymnasium Type "A"

ITEM	NUMBER OF PIECES	SIZE	GRADE	NO. BD. FT. OR QUANTITY	COST
Truss Bracing	31	2" x 8" x 20'-0"	No. 1 D.F.	830	
Truss Bracing	35	2" x 8" x 24'-0"	No. 1 D.F.	1120	
<u>ROUGH HARDWARE FOR BRACING</u>					
Machine Bolts	32	$\frac{1}{2}$ " $\emptyset$ x 15"			
M.I. Washers	64	$\frac{1}{2}$ " $\emptyset$			

APPENDIX B: ENGINEERING SECTION, 1946

Excerpts from the "Engineering Section," by Arthur M. Sandridge and Oliver E. Sisler.
Manzanar Relocation Authority, February 1946, part of the War Relocation Authority.
Final Report, Manzanar War Relocation Center. "Chapter 2. WRA Construction, Part I.
New Construction. B. Gymnasium-Auditorium." Document on file in National Archives.

ENGINEERING SECTION

by

ARTHUR M. SANDRIDGE
Senior Engineer
June 15, 1942—March 1, 1946

and

OLIVER E. SISLER
Superintendent, Maintenance and Construction
October 12, 1942—February 15, 1946

Manzanar Relocation Authority
Manzanar, California

February 1946

NEWSPAPERS

Manzanar Free Press. A complete run of this newspaper in Collection No. 122, Manzanar Collection, in the Special Collections Library of the University Research Library at the University of California at Los Angeles is the set used in research for this report. It is believed the National Archives also has a complete run of the paper, and several other repositories may have partial or complete runs.

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oring	12,083	1" x 4" P & G	"C" V.G.D.F.12,083	
inish	sq.ft.			
ails under				
Steps	40	2" x 6" 12'-0"	D.F.No. 2	225
Steps, sleepers				
Footings	50	3" x 14" x 14"		
Between finish &				
Sub-floor	12 squares	6 lb. Bldg. Paper		
Steps at Sleeper				
Steps	40	1" x 2" x 16'-0"	D.F. #2	100

CHAPTER 1

BASIC CONSTRUCTION

The story of the construction of the Manzanar War Relocation Center, its maintenance, and operation from March 1942, to November 1945, is related in the following report.

Construction began in March 1942, when an area of desert land in Owens Valley was cleared of sage brush and a temporary city was set up for 10,000 people. To establish this Center, it was necessary for engineers and construction men to prepare plans: to construct buildings, water and sewer systems, and all other facilities necessary for a city of this size; and to do this as expeditiously as possible.

The following temporary buildings and appurtenant facilities at Manzanar were constructed under the supervision of the U.S. Engineers of the Los Angeles Metropolitan Area.

I WATER AND SEWAGE DISPOSAL SYSTEMS

(Contractor: Vinson and Pringle, Los Angeles, California)

A Water

A concrete dam and settling basin were constructed on Shepherd Creek, approximately 3,250 feet north and west of the Center in T 14S, R35 E, Sec. 9, assuring the Center of an adequate water supply. Water was carried through an open flume from the settling basin to the storage reservoir. This reservoir, 120 ft. x 180 ft. with a capacity of 540,000 gallons, was constructed with 45-degree earth embankments reinforced with wire mesh and lined with concrete. Two 14-inch calico gates regulated the water within the reservoir. One gate emptied into a control spillway and the other emptied into a 14-inch supply line.

From the reservoir the water was carried through 4,650 feet of 14-inch welded steel pipe into a 90,000 gallon steel storage tank. An 8 ft. x 22 ft. chlorinator house of temporary frame construction was built adjacent to the storage tank for the housing of an H.T.E. chlorinator machine, Clayton valve, sand traps, meters, and a 6-inch by-pass line. The water line from the reservoir to the storage tank was laid in the open ditch that carried the temporary water supply into the camp area. This line was insulated by covering it with an earth fill. Drainage facilities were provided by the installation of hexagonal wooden culverts placed below the level of the pipe line.

The construction of the pipe line and the steel storage tank was done by the Los Angeles Bureau of Power and Light. The insulation of the pipe line and the installation of the wooden drainage culverts were done by C. J. Paradise Company, of Los Angeles.

From the storage tank a 12-inch distribution main of welded steel pipe, equipped with 12-inch Sparling meter with a capacity of 2,000 gallons of water per minute, carried the water to branch mains throughout the Center. There were 5,170 feet of 12-inch, 6,340 feet of 10-inch, 8,822 feet of 8-inch, 29,745 feet of 6-inch cast-iron pipe and 706 feet of galvanized steel pipe installed to construct the system of water distribution mains. All service lines installed were of galvanized iron pipe ranging in size from 3/4-inch to 2 1/2 inches. A total of 40,266 lineal feet was used on this installation.

An emergency stand-by system was installed to supplement the water supply during freezing weather and in the event of a bad

fire, which would necessitate the use of more than the normal amount of water supplied by Shepherd Creek. This installation was made at well 75, and consisted of one 10,000-gallon redwood storage tank, and two 4-inch 50 horse power motor driven Fairbanks Morse booster pumps. Water was pumped through a master meter into the storage tank by the City of Los Angeles pump with a 75 horse power electric motor. From the tank the water was pumped into the mains by the Fairbanks Morse booster pumps.

There were 34 6-inch, 20 8-inch, 15 10-inch, and 8 12-inch gate valves installed throughout the water system to facilitate the control of water within the Center.

Fire protection was provided by the installation of 84 fire hydrants and, as an additional protection for the hospital, an automatic sprinkler system was placed in seven ward buildings, the hospital mess, and the covered walks. This system was made up of 522 sprinkler heads. In the covered walks a 3-inch pipe was used and reduced to 1-inch pipe in the wards and mess hall.

E Sewage Disposal

The sewage disposal system, as installed, consisted of a collection and outfall system and a sewage treatment plant. During the construction period temporary septic plant, 100 ft. x 20 ft. x 6 ft., was used. All sewage entering this tank was treated with chlorine.

The collection system within the Center consisted of 2,500 lineal feet of 18-inch, 1,100 lineal feet of 15-inch, and 26,902 lineal feet of 8-inch vitrified clay pipe. A siphon was constructed to carry the outfall line under the Los Angeles aqueduct. This siphon was made up of two 12-inch cast-iron pipes encased in concrete.

After leaving the outfall sewage line, the raw sewage entered the treatment plant which had a designed capacity of 1.25 million gallons per day, and was composed of the following units; (1) grit chamber, (2) scum and distribution box, (3) clarifier, (4) control house, (5) digester, (6) chlorine contact tank, and (7) sludge beds.

The grit chamber, scum and distribution box, clarifier, digester, and chlorine tank were all constructed of concrete.

The sewage first passed through the grit chamber which was equipped with bar screens; then it entered the parshall flume. The metering and extension of the chlorination system was done within the flume. The sewage left this unit to enter the distribution box, which consisted of two calico gates.

The clarifier unit was a tank constructed of concrete, 60 feet in diameter and 9 feet in depth. This tank was equipped with the necessary mechanism to properly process the sewage that entered this chamber. The rate of flow of this tank varied from 500 to 1750 gallons per minute.

The control house was a 32 ft. x 58 ft. frame building with concrete floors, rustic siding and roll roofing. This building contained the office room, laboratory, metering, the chlorinator control, and other equipment. Manual and automatic type control chlorinators were used, with a maximum capacity of 200 pounds of chlorine per unit for each 24 hours. Each tank was equipped with a meter to register the flow of chlorine within its working range.

The sludge and scum pumps were housed in a concrete pit, 16 ft. x 14 ft. x 5 ft., with a frame roof covered with roll roofing to protect them from the weather.

The sludge digester was the 2-stage type, 40 feet in diameter with 22 feet 6 inches overall water depth. The water depth in the upper compartment was 12 feet 3 inches and the lower compartment was 10 feet. The digester was arranged with a horizontal concrete tray separating the lower and upper compartments which were operated in series. Intensive mixing was provided in the upper compartment followed by quiescent settling in the lower compartment. The two compartments were connected by exterior piping.

The chlorine contact tank was made of reinforced concrete with reinforced concrete baffle walls. The dimensions were 8 ft. x 16 ft. 6 in. x 38 ft., equipped with three standard manhole frames and covers. A 6-inch cast-iron pipe to the scum pump line removed any collection of material in the bottom of the tank. An 18-inch cast-iron influent pipe served the contact tank from the clarifier.

The chlorinated sewage was removed to the drainage area through an 18-inch vitrified clay pipe.

Four sludge or drying beds, 50 ft. x 100 ft., were constructed. The ground surface was leveled and dikes or berms $3\frac{1}{2}$ feet high were constructed. Then six inches of sand was placed in each bed. The sludge was carried to these beds through a 6-inch cast-iron pipeline.

The plant was located east of the Center approximately 4,000 feet in T 14 S; R 35 E; S.W. $\frac{1}{4}$ of Sec. 12.

II ELECTRICAL DISTRIBUTION AND SIGNAL SYSTEMS

A Electricity

Electricity was furnished by the Los Angeles City Bureau of Power and Light from its power station on Cottonwood Creek. The system consisted of 58,400 lineal feet of overhead distribution lines and service to 730 buildings. A master switch controlled the entire camp, and a master meter registered all the electricity used within the camp. In addition to lighting the buildings, 190 alley and street lights were served.

To service the camp, 79 transformers as listed below were installed:

<u>Size</u>	<u>Number</u>
2 K.V.A.	2 ea
3 K.V.A.	2 ea
5 K.V.A.	7 ea
7½ K.V.A.	4 ea
10 K.V.A.	2 ea
15 K.V.A.	33 ea
25 K.V.A.	24 ea
37½ K.V.A.	5 ea

B Telephone

The telephone system was installed by the Interstate Telegraph Company. The telephone wires were strung on cross arms that were installed on existing power poles. A 40-line switch board ~~was installed on the system.~~ The installation of seven miles of 3-circuit #9 wire and seven miles of 2-circuit #12 N.B.S. copper wire was necessary for the completion of this project.

C Fire and Police Signal System

A signal system was installed by the Interstate Telegraph Company under contract with the U.S. Signal Corps and was deemed

a necessity to provide the Center with a signal system adequate for the needs of both the Fire Protection and Internal Security Sections.

Outside installations included cross arms and approximately 1,500 feet of lead covered cable and 20,700 lineal feet of 2-wire telephone line.

Inside plant and station equipment consisted of the installation of an additional strip of 10 jacks in existing switchboard and the installation of 21 telephone instruments, drops, protectors and appurtenances.

III BUILDINGS AND STRUCTURES

A General Group

Griffith and Company of Los Angeles were the general contractors on all temporary buildings and structures within the Center. This included the installation and furnishing of all plumbing equipment and fuel oil lines.

These temporary buildings were regular Army Theater of Operations (T.O.) type of construction, supported on precast concrete blocks, 14 in. x 14 in. x 8 in. These blocks were placed on 10-foot centers down the sides and through the center. Girders constructed of 2 in. x 6 in. material, spiked together to form 2 in. x 6 in. for the outside and 6 in. x 6 in. for the center span, supported 2 in. x 6 in. floor joist spaced 2 feet on centers. The floors were 1 in. x 6 in. tongue and groove or 1 in. x 6 in. shiplap. The walls were framed from 2 in. x 6 in. material spaced 8 feet on centers. A 2 in. x 4 in.

nailing girt, spaced half the distance between the top and bottom plates, furnished center nailing for the sheathing that was applied vertically. The rafters were of 2 in. x 4 in. material spaced 48 inches on centers with a double 1 in. x 6 in. ceiling joist or cord, and 2 in. x 6 in. knee bracing on every other set of rafters. The roof was sheathed with 1-inch random width sheathing and covered with 45-pound roll roofing. The walls and gables were covered with 15-pound building paper, held in place by 3/8 in. x 2 in. lath or batts. The barrack-type buildings were equipped with sliding 4-light sash windows, size 36 in. x 40 in., and 12 sash on each side. The warehouse group had the same type window but was reduced to six windows to each side with a 5 ft. x 7 ft. double door in each end.

The buildings of the foregoing description that were constructed are listed in Table 1.

TABLE 1
NUMBER, TYPE, AND SIZE OF BUILDINGS CONSTRUCTED IN MANZANAR

Type	Size in feet	Use	Number
Barracks (apartments)	20 x 100	evacuees	504
Mess halls	40 x 100	evacuees	36
Bath and latrines	20 x 30	evacuees	73
Recreation halls	20 x 100	evacuees	36
Ironing rooms	20 x 28	evacuees	36
Laundries (cement floor)	20 x 50	evacuees	36
Warehouses	20 x 100	storage	40
Car garages (no floors)	20 x 100	Government cars	2
Truck garages (no floors)	20 x 100	Government trucks	2
Total			764

B Military Police Group

(Contractors: Griffith and Company, Los Angeles, California)

The general construction of the building at the Military Post was typical of the general group in the Center except for the following changes. The exterior walls were covered with 1 in. x 10 in. drop siding and the interior walls and ceilings were lined with $\frac{1}{2}$ -inch sheet rock. All exterior walls were painted as a protection against the weather. A list of these buildings is found in Table 2.

TABLE 2

NUMBER, TYPE, AND SIZE OF BUILDINGS CONSTRUCTED AT MILITARY POST

Type	Size in feet	Number
Barracks	20 x 100	4
Officers' quarters	20 x 100	1
Administration and store room	20 x 100	1
Recreation building	20 x 100	1
Mess halls	20 x 100	1
Guardhouse	20 x 50	1
First aid station	20 x 28	1
Bath and latrines (cement floors)	20 x 30	1
Motor repair building (cement floors)	31 x 79	1
Total		13

C Administration Group

(Contractors: Griffith and Company, Los Angeles, California)

The general construction of the Administration building was the same as at the Military Post, with the exception of the reception building or police station and the service station. These two buildings

were of the same construction as those in the general group. An enumeration and description of these buildings is given in Table 3.

TABLE 3
NUMBER, TYPE, AND SIZE OF ADMINISTRATION BUILDINGS

Type	Size in feet	Use	Number
Administration buildings	40 x 100	offices	2
Administrative service station	20 x 30	storage	1
Family apartment buildings	20 x 100	4 apartments each	2
Men's dormitories	20 x 100	6 apartments each	2
Women's dormitories	20 x 100	6 apartments each	2
Provost building	20 x 50	community government	1
Mess hall	20 x 100	dining-room	1
Reception building	20 x 100	police station	1
Total			12

D Hospital Group, Including Childrens Village

The group of hospital buildings was of the same type of construction as the general group with the exception of the heating plant. This building was wood frame construction with the walls and roof covered with galvanized corrugated iron. All buildings within this group were spaced a minimum of 50 feet apart and connected with covered walks. These structures were of wood-frame construction with wood floors covered with linoleum. The height was 8 ft 3 in. from the finished floor to the top of the plate line, with an overall width of 6 ft. 7 in.

The walks connecting the hospital administration building with the wards, mess hall, and morgue were closed on the sides with double-hung windows spaced, approximately, 9 feet on centers. These

walks connecting the nurses' and doctors' quarters to the ward walks were open on the sides with a hand rail extending the full length of each walk.

The heating system consisted of 3 Kewanee 60-H.P. oil-fired steam boilers, equipped with Johnston automatic oil burners, and all necessary piping valves, pumps, and radiators for complete and adequate heating of all buildings, and for washing and sterilizing in all wards, operating rooms, offices, clinics, and laundry.

The Childrens Village (orphanage) buildings were in a separate group and were not heated by the hospital heating plant. Each building within this group was heated by oil-burning space heaters.

The hot water system consisted of one 60-gallon H.C. Little automatic hot-water heater for each building.

The buildings in the hospital group are listed in Table 4.

TABLE 4
NUMBER, TYPE, AND SIZE OF BUILDINGS IN HOSPITAL GROUP

Type	Size in feet	Capacity	Number
Administration building	25 x ~~100~~		1
Obstetrical ward	~~25~~ x ~~100~~	35 beds	1
General wards	~~25~~ x ~~100~~	~~35~~ beds ea	4
Isolation wards	25 x 150 $\frac{1}{2}$	30 beds, ea	2
Mess hall	40 x 60	—	1
Doctors' quarters	20 x 100	5 doctors	1
Nurses' quarters	20 x 100	23 nurses	1
Hospital laundry	20 x 100	—	1
Hospital morgue	23 x 33 $\frac{1}{2}$	—	1
Heating plant	40 x 38	—	1
Warehouses	20 x 100	—	2
Childrens Village	25 x 150	33 beds, ea	3
Total			19

E Miscellaneous Group

Under this miscellaneous group are listed and described all buildings and structures not included in the groups previously discussed.

1 Refrigerator Warehouses (Contractors: Griffith and Company, Los Angeles, sublet to Hugh Robinson and Sons, Los Angeles.)

There were two refrigerator warehouses that had an overall size of 20 ft. x 100 ft. with approximately 7 ft. 6 in. ceilings. The refrigerator rooms proper were 20 ft. x 80 ft. with 7-ft. ceilings, and were insulated with 6 inches of Palco-wool on the sides, ceilings, and floors. The doors at each end, 3 ft. 6 in. x 6 ft. 6 in., had 4 inches of Palco-wool for insulation. The interiors of these rooms were ceiled with 1-inch tongue-and-groove ceilings. The exterior finish was 1-inch sheathing covered with 15-pound building paper and 3/8 in. x 2 in. batts to hold the paper in place. An annex, 20 ft. x 40 ft. connecting the two refrigerator houses, was used for meat cutting and the sorting of fruits and vegetables.

Each room had four evaporator condensers, recold humid-air type, model Bu. 255, that were spaced equally in length of the room with end units $\frac{1}{2}$ spacing from the wall. These units, operating on defrost, maintained a 34-degree to 36-degree temperature in the meat refrigerator, and 38- to 40-degree temperature in the vegetable refrigerator.

The compressor and condensing units were housed in a 10 ft. x 10 ft. room, an integral part of the refrigerator rooms. The

compressors were Brunner, model E, Type C, driven by a 7½-H.P. 220-volt, 3-phase Fairbanks Morse electric motors. Drayer Hanson condensing units, model 1¼-inch, L-3, ¾-H.P. were used on both units.

2 Net Garnishing or Camouflage Buildings (Contractors: Q.R.S. Neon Corporation, Los Angeles, California)

Five buildings were constructed for the garnishing or camouflaging of nets for Army use. Three of these buildings were of uniform size and construction. They were 300 ft. x 24 ft. with an overall height of 18 ft. from finished floor to plate line. Two of these buildings had additions, 12 ft. x 20 ft., with shed roofs and were used as offices for the group.

Heavy construction was used throughout. Posts measuring 6 in. x 12 in. on 10-foot centers supported a double set of 2 in. x 6 in. rafters bolted to each side of the post. These rafters were tied together with a 2 in. x 6 in. cord and 2 in. x 6 in. knee braces, extending from approximately 2 feet below the plate line forming a modified form of scissors truss. Intermediate 2 in. x 6 in. rafters with 2 in. x 6 in. cords and spaced 2 feet on centers completed the roof framing. The roof was covered with 1-inch random-width sheathing laid diagonally and covered with 90-pound roll roofing.

The walls were constructed with two horizontal 2 in. x 4 in. nailing girts and 2 in. x 6 in. verticals spaced on 2-foot centers. The sides were covered with 10-inch drop siding from the floor to 10 feet above. The ends were covered from the floor to the ridge. The walls were braced with 2 in. x 6 in. bracing. Cement floors were used throughout.

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